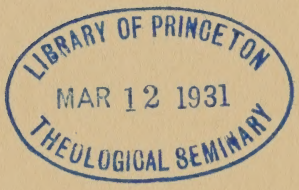

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The Terry Lectures

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Nature : Cosmic, Human and Divine

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NATURE: COSMIC HUMAN AND DIVINE

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BY

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PREFACE

IF Francis Bacon could worthily say in the seventeenth century 'I have taken all knowledge to be my province', such a remark by any individual to-day would raise an immediate suspicion as to his sanity. Yet if the title of these Terry Lectures may faintly suggest such temporary loss of balance, a threefold reply is still possible. In the first place, the rapidly increasing specialism in scientific research, and its demands upon the worker's time, will probably sooner or later result in the development of a class of teachers who, having passed through a scientific discipline, will require to devote most of their energy to the exposition of the subject-matter of their particular science as a whole, studying also its bearings on closely related sciences, and human life and thought in general. In the second place, before this development has fully come about, it is essentially a helpful service to the fellowman when individuals like the previous Terry Lecturers, distinguished in some particular field, are willing to offer the fruit of their reflection upon the relation of the fresh knowledge accumulating in their field to the most fundamental problems of life. And even lesser communications may have their value, for it is

obvious that the interest here may vary in degree and range. In the third place, it is only as we realize the prodigious advances in knowledge that have characterized the opening decades of this century, that we shall really appreciate its greatest concomitant peril, viz. the possible misuse of that knowledge through the circumstance that man's moral development lags far behind his growing control of the forces of Nature. This situation, together with a hypertrophied sense of Nationalism consequent in part on the rapid increase in population, constitute the two real menaces of the future.

It remains for me to place on record my deep appreciation of the honour bestowed in nomination to this Lectureship, as also to thank my friends Professor Daniel Lamont and Dr. Mitchell Hunter, who kindly read the lectures in the original typescript, and offered helpful suggestions. Finally, I would acknowledge the courtesy of the Oxford University Press, the Cambridge University Press, the University of Chicago Press, and Macmillan & Co., for permission to quote from the books published by them which are referred to in this work.

J. Y. SIMPSON.

25 CHESTER STREET,
EDINBURGH.

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LECTURE I

NATURE: COSMIC

DURING these days we are passing through a Re-formation of thought as profound as anything that passed under that name in the sixteenth century. Like its great prototype, our Reformation has its political, economic, social, and religious aspects; it, too, will last through many decades. Those of us who, if for no other reason than that of years, have the necessary background against which to measure the degree of change, turn sometimes with a pathetic wistfulness to Wordsworth's well-known lines in his sonnet on the French Revolution:

> Bliss was it in that dawn to be alive,
> But to be young was very heaven!

There may be those who say they are quite unaware of any such change as has been indicated. They realize that the motor-car, the cinema, and the radio have altered to a very considerable degree the setting and mode of human life within a single generation, but of this intellectual or spiritual (as opposed to purely material) readjustment and transformation they are totally unaware.

Now this need not be the result of mere ignorance or dull stupidity. It is not at all easy to appreciate the significance of such a movement when one is in it, however alert one may be. I believe it would not be difficult to put together an imposing array of sayings from Luther indicating that he had comparatively little idea of the ultimate character, scale, and implications of the movement that developed around him in the first instance. Like Lenin, in a later crisis, he might have said, 'I don't yet know where I am going to, but I am going there resolutely.' I recollect discussing with some of the best informed people in Russia in 1915, 1916, and 1917 the events both preceding and immediately succeeding the 'Ten Days that shook the World', and in retrospect I can see that only one had any inkling of what eventually happened, and he was not a Russian. One Russian diplomat in particular whose insight appealed to me by his statement in the second year of the War that the only two elements likely to gain as the result of that titanic struggle would be Woman and the Roman Catholic Church, seemed a promising source for impressions and realization of what was going on in the Russian capital during the historic days in February 1917. The reply I got seemed astonishing. 'I realized nothing of what was

really happening. I sat in my father's library and read the works of Joseph de Maistre.'

It is not easy, I repeat, to grasp the significance of what is happening. Yet we are in the midst of a movement in thought comparable to one of the 'major revolutions' of the geologist—those movements of upheaval of land masses and continental areas which mark off the end of one secular aeon and the beginning of another. Such, for example, was the 'revolution' which brought about the Pleistocene, and has issued in a 'grander, more diversified, and more beautiful geography' than the earth's landscape has ever shown before.[1] It may be that from this intellectual upheaval a corresponding result may eventually follow.

Of evidence of such radical change all who are familiar with present-day scientific and philosophical thought will recall many examples. 'Now that a definite connection has been set up between electricity and gravitation', said Professor E. T. Whittaker in a comparatively recent Presidential Address to the Mathematical Section of the British Association, 'the whole of electro-magnetic theory must be rewritten',[2] and

[1] Cf. Charles Schuchert in *The Evolution of the Earth and its Inhabitants*, p. 71.

[2] *Report of Brit. Assoc. for Advancement of Science*, 1927, p. 17.

the process is already in operation. 'Neither total energy nor total mass is any longer constant', Sir James H. Jeans has stated; 'the conservation both of mass and of energy has disappeared from physics, and only a kind of sum of the two is conserved'.[1] 'It would be difficult to say', said Professor Eddington in a Gifford Lecture, 'what is the accepted theory of stellar evolution to-day. The theory is in the melting-pot and we are still waiting for something satisfactory to emerge. The whole subject is in doubt and we are prepared to reconsider almost anything.'[2] Nor is the situation in any way different in biology. If one were to attempt to summarize in a single sentence the present state of opinion of those whose work, however great or small, entitles them to an opinion, one could only say that while the doctrine of descent with modification from pre-existing forms is more surely founded than ever, there has never been a time when the method of evolution has been so much the subject of debate, or the question of the factors involved in such comparative obscurity.

'In biology', says de Beer, in his *Introduction to Experimental Embryology*, 'the experimental method is

[1] 'The Physics of the Universe', *Nature*, 122, p. 697 (3 Nov. 1928). [2] *Stars and Atoms*, p. 109.

revealing phenomena which one must call "biological properties" of living matter; such as the organization of the axial structures by the dorsal lip of the blastopore or the formation of a lens by the activity of the eye-cup. . . . It is idle and absurd to imagine that experimental embryology will explain the development of organisms.'[1]

Or once again, in his admirable volume on *The Species Problem* (1928), Mr. G. C. Robson of the Department of Zoology in the British Museum writes:

'Some doubt has been expressed as to the right of positive science, in this case of Biology, to pronounce a final verdict on the manifestations of life. According to Bergson . . . "the inert enters naturally into the frames of the intellect, but [that] the living is adapted to those frames only artificially, so that we must adopt a special attitude towards it, and examine it with other eyes than those of positive science". I am prepared to believe that M. Bergson is correct in this view. . . . I agree with M. Bergson that science, theory of knowledge and metaphysics should meet on the same ground. But I feel that not only must they "pool" their effects, but that each must test its affirmations by its own appropriate technique.'[2]

The danger of course is that in quoting more of the many critically hesitant conclusions and insistences on suspended judgement of which this particular volume is strikingly full, or even the famous yet much misused pronouncement of

[1] pp. 133, 134. [2] pp. 149, 150.

Bateson[1] on the origin and nature of species, we give an impression of the apparent futility of biological research, which only perversity of mind could regard as being the real core of the statement. But, to speak broadly, nothing is more characteristic than the changed temper in the camps of science. Victorian cocksureness and arrogance have been superseded by a Georgian hesitancy, or, shall we say, open-mindedness and humility.

It is impossible to suppose that such a state of frank reconsideration and restatement in the natural sciences can be without influence upon the related fields of philosophy and religion. In philosophy notoriously there is a similar situation. To-day there are no general movements of thought—only individuals, as, e.g., Alexander, Dewey, Whitehead, who all differ from one another in outlook. Yet even if in religion the corresponding turmoil means no more than what was long ago described as 'the removing of those things that are shaken, as of things that have been made (e.g. much theological dogma), that

[1] 'In dim outline evolution is evident enough. From the facts it is a conclusion which inevitably follows. But that particular and essential bit of the theory of evolution which is concerned with the origin and nature of *species*, remains utterly mysterious' ('Evolutionary Faith and Modern Doubt', *Nature*, 109, p. 553).

those things which are not shaken may remain',[1] the generation that has to live through the process, just in so far as it is in earnest, must experience anxious and responsible searching of mind and even of heart. Possibly the extravagances of so-called Fundamentalism, or the deserved interest in such pronouncements as those of Barth of Münster, are just part of a protest from a religious element that is afraid of losing its bearings altogether in the maelstrom of readjustment and the uncertainties of 'relativity of thought', and cries aloud from its heart in the quest of things that cannot be shaken and a standpoint that is fixed.

It is difficult to realize that we look out on a universe hundreds of thousands of times larger than anything that our fathers knew, and its extension in time is of the same order as its extension in space. The change, of course, is not in the universe: it is in our thoughts concerning it. It is a universe composed of different kinds of entities, all of which—astronomically speaking—are probably now known to science. It does not seem likely that types other than the present-day distinctive forms of celestial structure, such as spiral nebulae and ordinary stars, star-clusters and binary stars, and so on, will be henceforth

[1] Heb. 12, v. 27.

discovered, although much has to be learned about the individual objects, and increasing numbers of them are disclosed with every advance in telescopic penetration. Yet every advance up to the limits of the known, whether in the direction of the very minute or of that of the almost inconceivably great, only seems to open up still longer vistas into a further Beyond. Thus more particularly as the result of researches by Professor G. P. Thomson of Aberdeen,[1] based on the brilliant work of Prince Louis de Broglie, the old conception of the electron as a single point charge of negative electricity surrounded by a structureless medium has begun to pass. He has been able to show that even a uniformly moving electron is always accompanied by a series of waves which seem to carry it along and determine its direction. The moving electron, as likewise the proton, is therefore a very much more complicated structure than was originally supposed, being composed both of corpuscles and of waves; the nucleus of an atom is enclosed in a field of very high potential. Indeed the recent discoveries tend to show that 'the electron is not the final stage in the structure

[1] Cf. G. P. Thomson, 'The Nature of an Electron', *Nature*, 122, pp. 279 ff. (25 Aug. 1928), and Sir J. J. Thomson, *Beyond the Electron*.

of matter but that it has itself a structure, being made up of smaller parts which carry charges of electricity'.[1] It may be that there is not constant specificity of type even on the electronic level. We might even say that the exploration of what lies 'beyond the electron' had only just begun, were it not that Professor Eddington recently spoke of it as a 'dummy', a mere aid to our inadequate intelligences confronted with specific physical problems, replaceable on occasion by some other conception, and with no more substantial existence than the ether. Of what preceded the primeval nebula we have no knowledge, and are not likely to learn with any exactness now. It is much easier to see how and whither things are going, than how or whence they came to be.

Obviously the process of readjustment in thought does not come in all cases with the same ease. Yet every man who is worth the name is driven back, at some time, by one cause or another, upon ultimate questionings. Is life a drama or a drift ? Is this vast process, of which he is a constituent part, and into which he was thrust without any consultation on his part, really getting anywhere ? Is there in evolution the deliberate development of a great idea

[1] Sir J. J. Thomson, *op. cit.*, p. 33.

dimly cognoscible as a whole by our limited human intellects, or is it merely a chapter of happy and unhappy accidents and incidents? I believe that upon a reasoned answer to questions such as these, in the light of the combined revelations through science and religion, men will increasingly come to shape their lives, for they are looking for a view that will provide a worthy motive for living. As life becomes increasingly rich and meaningful for greater numbers of human beings, there will be ever deeper questionings as to its ultimate meaning, if such there be. The biggest question that men have to face to-day—Is there purpose and meaning in the world-process?—cannot be answered by any sectional or partial reference that excludes the sweep of the inorganic. It was only human vanity that ever supposed it could. Until we reach a satisfying view of the universe based on the revelation of itself, it is futile to expect to be in a position to secure a satisfactory view of man, simply because to-day his genetic and organic relation to a portion of that universe is amongst the most assured and fundamental facts that we have to face. Up till now men thought to reach a satisfying view of man on the basis of psychological introspection or revealed religion, and comparatively little attention was devoted to the

universe as a whole, simply because not very much was really known about it. On this account, not merely theology, but culture and civilization, are seen to-day to be in a state of confusion. The old supports—or we should better say, pendants—have gone, and there is nothing to take their place, because men have not been particularly interested to find what there undoubtedly is to set in their place. We have to get a theory of the Whole from which we may work down, on the basis of our facts, to a theory of that part, Man, who supremely concerns us. And it is because we have no worthy nor true theory of the Whole that for the moment civilization—the united progressive effort of man—halts in its tracks. The traditional standpoint, beginning with certain views of man, is in the opinion of many utterly outworn and *démodé*: it is not in any large measure true to fact as we know it to-day. It may have been true within the very partial limits of its day, but to continue to maintain it is to do a real disservice not merely to religion but to all truth. And this is not to ignore but rather to affirm afresh all that is most wonderful in Man—his power to set himself in thought over against even that Whole, his unique potentialities for good and evil, his salvability. Since, then, a man's thought must be inevitably

affected to some extent by the kind of cosmological background which he, consciously or unconsciously, has to it, and indeed ought to be actively affected in a way to which many are quite insensible, it seems worth while to try once again to reach some general conception of Nature, Cosmic, Human, and Divine, if thereby we may receive some hint of Nature Divine that will point beyond herself to a Divine Nature in which she ultimately lives and moves and has her being, and we with her. Yet this is the kind of effort at which many still look askance, and which is easily liable to misunderstanding. In an emphatic passage in his recent magistral book, Professor A. S. Eddington says: 'I repudiate the idea of proving the distinctive beliefs of religion either from the data of physical science or by the methods of physical science.'[1] As only four pages later he asserts that '*Proof* is an idol before whom the pure mathematician tortures himself', whilst the physicist is 'generally content to sacrifice before the lesser shrine of *Plausibility*', this vigorous repudiation of an idea which could only be held under a misapprehension seems a little unnecessary. And it is misapprehension, for if God exists, He must be the Self-caused, and therefore not susceptible of demonstration as

[1] *The Nature of the Physical World*, p. 333.

that term is ordinarily understood, inasmuch as it implies the conception of the relation of effect in the thing demonstrated to some cause or another. On the other hand, if, at the least, a comparable degree of plausibility for a Natural Theology cannot be reached on the basis of the growing understanding of Nature, then I think we are face to face with a really serious situation. I have read airy statements in the interests of Religion, as that 'we do not go to the Cosmos for our conception of the character of God', but the dilemma cannot be side-stepped in that simple way, true though the statement be, up to a point. For the Cosmos is there, looking us straight in the face as it were, and we have to come to terms with it: nor will it let us ignore it, for it is not unfriendly to us. If God exists, the Cosmos must stand in some sort of a relation to Him and He to it, and man is its climactic genetic product. It is therefore conceivable that from it we may learn, and have yet much to learn, of the divine wisdom, power, truth, and even grace.

Our first inquiry accordingly concerns itself with Cosmology, or the account of the scheme of things—if scheme there be—which may be put together on the basis of recent physics and astronomy, using these terms in a very broad sense. One of the difficulties here is that for the

average man large numbers have little meaning. In the vestibule of the Department of Mathematics in a certain Scottish University you may see a great map-like sheet showing a scheme of regimented dots in square formations of hundreds, and tens of thousands up to the total of one million, but even such visual aid is of little material assistance in attempting to represent to ourselves the scale of the universe.

Let us call the earth-sun distance (93 million miles) one inch. On this scale, in popular speech, the earth would appear as a microbe, and the sun as a grain of sand. On this same scale, as it happens, a light-year[1] is a mile. At about four to five miles on this scale we begin to come to the nearest stars, each of them roughly like a grain of sand, with something of the same distance between them. At about 200 miles we should reach the planetary nebulae, and at 600 come to the giant nebula of Orion. But it would be 20,000 miles on that scale before we arrived at the globular star clusters, which are directly connected with the Milky Way. The famous star cluster known as ω Centauri is composed of thousands of stars. Its distance has been calcu-

[1] A light-year represents the distance traversed by light travelling for a year at the rate of 186,000 miles a second: equivalent to nearly 6 million, million miles.

lated by Harlow Shapley as 20,000 light-years. That is to say, the light messages that we receive from the cluster to-day left it 20,000 years ago—in the days of the Magdalenian reindeer hunters of Aquitaine. Beyond the Milky Way are the spiral nebulae, at half a million to a million miles on our particular scale. The origin and relation of these 'island universes' to our universe is still unknown. On a calculation made by Dr. Hubble of the Mount Wilson Observatory, the distance of one of the remotest of these spiral nebulae (M 33 Trianguli) is 857,000 light-years. On the same scale the nearest 'fixed' star is distant only four light-years.

This sense of overwhelming immensity follows us in all astronomical adventure. The stars in our own system number thousands of millions. In the extra-galactic nebulae they exist, either developed to star estate, or in process of development, to the number of a thousand millions in each of two million such galaxies. And they in turn are not unrelated to our system, but suggest that with it they form a system of systems—something orderly and intelligible throughout. Indeed it is this sublime orderliness which has always impressed those whose business has been with the courses of the stars. In the words of a distinguished researcher:

'To an astronomer the most remarkable and interesting thing about that part of the physical universe with which he has become acquainted is not its vast extent in space, nor the number and great masses of its stars, nor the violent forces that operate in the stars, nor the long periods of astronomical time, but that which holds him awestruck is the perfect orderliness of the universe and the majestic succession of the celestial phenomena. From the tiny satellites in the solar system to the globular clusters, the galaxy, and exterior galaxies there is no chaos, there is nothing haphazard, and there is nothing capricious. The orderliness of the universe is the supreme discovery in science; it is that which gives us hope that we shall be able to understand not only the exterior world but also our own bodies and our own minds.' [1]

It may of course be urged that in the light of what has been called the 'principle of indeterminacy' or 'limited measurement' enunciated by Heisenberg, and the new quantum work,[2] statements of this nature are now meaningless, and that a great Irrationality has been disclosed at the heart of things. The subject is still in expert hands, but, so far, on the contrary, in its suggestion of a certain measure of spontaneity at the creative core of Being, it seems to supply one more indication that those are on sound lines

[1] Forest Ray Moulton, 'Astronomy' in *The Nature of the World and of Man*, p. 30.

[2] For an account cf. A. S. Eddington, *The Nature of the Physical World*, chapter x.

who are convinced of the existence of an 'organic category' more fundamental than anything in physics and chemistry, and are working towards the elucidation of it. It even hints at the interpretation of evolution in terms of the winning of freedom as being more ultimate and comprehensive than had hitherto been supposed.

Of the extent of the universe, then, we are beginning to have some definite ideas, and certain other considerations as to its form follow in part from acceptance of the implications of Einstein's General Theory of Relativity. One of these is the curvature of space-time with its implication that the paths of rays of light continue till they may re-enter on themselves. Even if objects were disclosed by some still more powerful telescope at one thousand times the distance of the farthest spiral nebula, yet the trend of suggestion is towards a limited or finite universe, if of immense dimensions. Professor Whittaker estimates that the length of the radius of curvature of the universe is probably of the order of about 100 million light-years.[1] As William Blake put it,

'The starry heavens reach no further, but here bend and set
On all sides.' [2]

[1] *Brit. Assoc. Report*, 1927, p. 25. [2] *The Creation.*

To the poet the sense of the Whole comes first: to the man of science it comes last, and sometimes never at all.

In the attempt to form a picture of the size and shape of the universe, we may think of the stellar system surrounding our sun, composed of thousands of millions of stars, as shaped like a flattened disc or lens, the outer section or rim of which in particular is constituted by the circling streams of stars known as the Milky Way. The average diameter of this lens is calculated to be some 220,000 light-years, while the greatest thickness or depth may be as much as 20,000 light-years, but is more nearly 8,000 over the whole. Observation of the motions of the stars has not merely dispelled the idea of 'fixed stars', but shows that it is not a random or haphazard motion. It is a motion determined certainly by the main gravitational field of the system to which the particular stars belong, but evidently with a preference for one particular direction in space.

If we now turn more particularly to our solar system, that part of the universe in which we are most at home, we are at once impressed by its comparative isolation. From Neptune, the outermost planet, to the nearest star (Proxima Centauri) is a distance of 25 million million miles.

Much used to be made of the almost central position of our earth in the actual supposed scheme of our stellar system.[1] To-day we realize that whatever that position is, it can only be relative to a larger scheme of things still very incompletely understood. On Harlow Shapley's estimate the sun is 'some sixty thousand light-years from the centre of the system', and 'is indeed perhaps half-way out toward the periphery of the greatly flattened discoidal and irregularly assembled stellar system'.[2]

We sometimes find a uniqueness claimed for the local cluster that constitutes our solar system which is, however, possibly more specious than real. We can calculate out the probabilities of such an arrangement of things occurring more than once, but we must not forget that at present we have no telescopes which could disclose systems of planetary satellites to other suns, supposing that they existed.[3] The fact remains,

[1] Cf. Alfred Russel Wallace, *Man's Place in the Universe*: 'The solar system is situated in the plane of the Milky Way, and not far removed from the centre of that plane. The earth is therefore nearly in the centre of the stellar universe' (p. 317).

[2] *Nature*, 122, p. 482 (29 Sept. 1928).

[3] The statement is certainly true with regard to small planets. The existence of very large planets might be detected through their disturbing the motion of their sun, or by eclipsing effects, but even this is improbable with present-day apparatus.

nevertheless, that nothing exactly like our solar system—a central sun, with its distinctive planetary accompaniment—has been disclosed up to date *by such telescopic power as we have*. Again, the origin of this related train of satellites presents rather a difficult problem in view of what is known to date about celestial origins. Various calculations lead to limits of between 1,500 and 5,000 million years for the age of the earth,[1] the larger figure probably being an outside limit, but within this period the loss of angular momentum or spin by the sun through radiation would have been too little to allow the suggestion, which has no other support, that the sun could ever have 'had more than a fraction of the angular momentum requisite for fission into a binary system'.[2] Accordingly, very largely by the process of critical exclusion of other conjectures, e.g. that of a rotational break-up, modern cosmogonists are driven to some tidal theory in explanation of the origin of our planetary system from the ancestral sun. This envisages the near approach and passage of some larger visitant in the earlier days of our sun's history. Under the

[1] Cf. Arthur Holmes, *The Age of the Earth*. 'A moderate multiple of a thousand million years' (Lord Rayleigh, *Report of British Association for the Advancement of Science*, 1921, p. 414).

[2] J. H. Jeans, *Astronomy and Cosmogony*, p. 387.

influence of the intense tidal action thereby set up, matter was drawn or ejected from the sun in the form of two long antipodal filaments or streamers, which condensed in sections or broke down under what has been termed 'gravitational instability' into the planets of the system. It is almost certain, that if formed in this way, the planets, or the originating filaments, had their origin in the outermost layers of the sun. A repetition of the same phenomenon with the sun (or the wandering star) acting as tide raiser, would account for the origin of the planetary satellites, our moon, perhaps, excepted. The theory implies, in each case, great condensation of mass in the parent body, but theory is surprisingly well borne out by fact.[1]

The claims for uniqueness and freak-formation in the case of our system seem then to be largely based on arguments from our ignorance, which is at once the broadest based and most slender of all arguments. What other stars may have planetary attendants we simply do not know and can only guess, but our guesses are not very impressive. 'Allotting an average age of 5×10^{12} years to the stars,' says Jeans, 'we find that only

[1] With this theory in its original form should always be associated the names of T. C. Chamberlin and F. R. Moulton. In no form is it as yet immune to criticism. (Cf. H. Jeffreys, *Month. Not. R. A. S.*, May, 1929.)

about one star in 100,000 can have formed a planetary system in the whole of its life, so that only about one star in 100,000 is at present surrounded by planets',[1] because there has not been time for more than this number to be born. Yet not merely have about 1,000 million stars been recorded photographically at Mount Wilson, but computations of the total number 'by extrapolation from known observational results' have been made, giving a figure of 30,000 million.[2] On the lower of these totals we already have 10,000 planetary systems, which is, however, hardly a sufficient basis for ascription of uniqueness or freak-formation. A case for uniqueness, however, might lie in the possible origin as a tidal effect. Jeans calculates that 'a given star is only likely to meet with actual collision once in 6×10^{17} years',[3] or as he puts it elsewhere, 'collisions between stars are so rare that they may be disregarded'.[4] As a matter of fact, it may be questioned whether any absolutely unequivocal instance of a collision between stars is on record —certainly there is no instance in which the two bodies were known individually before they collided—and the 'chance of a tidal encounter of sufficient intensity to break (a star) up into

[1] *Op. cit.*, p. 401.
[2] *Op. cit.*, pp. 16, 17.
[3] *Op. cit.*, p. 401.
[4] *Op. cit.*, p. 311.

a planetary system is somewhat, but not much, greater'.[1] On the other hand, it may well be that taking into account the greatly extended ages now attributed to the life of the stars, together with the probability that they were originally much closer together than they are to-day, the rarity of the event may have been lessened.

The secondary Wholeness of our solar system —the reason why it can be spoken of as a system at all—is attested by several more or less familiar facts. It is a fact of some import that an analogy can be drawn between the structure of the solar system and the constitution of an atom, both as regards the comparative distances of the orbital bodies (planets and electrons) from the central body, the approximately circular character of their orbits, the fact that all their orbits are described in the same direction, the comparative density of the central body in relation to the outer bodies, and, up to a point, the forces at work. Even if there are pronounced differences in that the orbital bodies in the one case (the electrons) are all of the same size or mass, and can jump from one orbit to another, which is not, of course, the case with the planets, and that the latter are arranged at irregular distances from the central nucleus or sun[2]—indeed the analogy can be

[1] *Op. cit.*, p. 401.

[2] Cf. Bode's Law.

easily overworked—yet it is a remarkable fact in demonstration of a *uni*verse that the ground plan of structure may be said to be roughly the same from the infinitely small to the infinitely great. While, within our system, 'one star differeth from another in glory' of size and brightness and colour, yet are they all essentially similar structures.

The very clearly marked galactic system is most satisfactorily accounted for on the supposition that our stellar system represents the last stage in the development of a spiral nebula. Some of the condensations in the outer regions of such younger spiral nebulae as have been photographed are on such a scale as to suggest that they are composed of clusters of stars rather than of single stars. Born as 'drops' in the outer cooling fringes of the great nebulae, the stars in their numbers punctuate the progressive stages in nebular evolution from the starless cloud of rotating gas to a sub-system like our own galaxy, where the nebular material is now comparatively at a minimum.

Attention has often been directed to the matter of attempting to locate the direction of the centre of the galaxy, on the supposition that our stellar system forms a spiral nebula. In his recent Halley Lecture devoted to this subject, Dr.

Harlow Shapley states that 'one investigation after another indicates an obscured region in the southern Milky Way, where the constellations Scorpio, Ophiuchus, and Sagittarius corner together, as the direction to the gravitational and rotational centre of the galactic stellar system'.[1] In this region, distant some 50,000 light-years, are concentrated the globular star clusters, and there are other indications of a highly massive nuclear concentration of stars—'at least', he has stated, '100,000,000 of them'.

Reference has already been made to other spiral nebulae and star clouds far beyond our own stellar system, constituting the so-called 'island-universes'. The term correctly suggests that, so far as known, they are all on a smaller scale than our system, which might therefore, perhaps, be held to play the role of continent to them, were there not so many of them. Thus the great nebula M 31 in Andromeda has a diameter roughly one-half of that of our stellar system, while its distance has been calculated by Hubble to be 926,250 light-years. Quite evidently such nebulae and star clouds, which appear to be all of comparable size, are outside our system, but that does not necessarily mean that they bear no relationship to it. Within a distance of 140

[1] *Nature*, 122, p. 482 (20 Sept. 1928).

million light-years it has been estimated by Hubble that 'about two million nebulae must lie, these being fairly uniformly spaced at distances of about 570,000 parsecs apart.'[1]

The continued study of these great nebulae shows that, like our stellar system, they are disc-like in shape for the most part, but more flattened, while the resolution of the outer regions into stars does not hold of the central portion. Although differing somewhat in structural detail, yet the great nebulae admit of orderly classification according as they are of regular shape and have no spiral arms, or exhibit a vaguely defined nuclear region from which two spiral arms emerge, in varying stages of development. The classification has been worked out in great detail by Dr. Hubble.[2] The spiral type is by far the more numerous. Many are known to be in rotation, and assume shapes which would follow from calculations dealing with such masses rotating under their own gravitation. Probably all of them are in rotation,[3] and this rotation is brought about by the principle of 'gravitational instability', which Jeans expounds at some length

[1] J. H. Jeans, *op. cit.*, p. 19. 1 parsec = 3.259 light-years.

[2] *Astrophys. Journal*, lxiv (1926), p. 321; cf. also J. H Jeans, *op. cit.*, chap. xiii.

[3] Jeans has actually calculated the period of rotation of M 31 in Andromeda at about 16 million years (*op. cit.*, p. 330).

in his recent classical work, for 'it provides simple, adequate and natural explanation of the creation of four generations of astronomical bodies, namely the great nebulae, the stars, the planets and the satellites of the planets'.[1] It presupposes a preliminary condensation in the primitive gaseous mass to account for the increase of thermodynamical energy, for which, however, no direct cause is suggested. Observation shows that the outer regions of many of these great nebulae are composed of stars, and we must suppose that they are formed by a process of condensation under gravity out of the nebular material. Theoretical considerations suggest that such condensations 'cannot form in elliptical nebulae which rotate as systems in a state of steady motion, or in the central masses of spiral nebulae, but that they must inevitably form in the equatorial extensions of the spiral nebulae'[2]—that is to say, only in bodies whose density is of a quite definite order of magnitude. This furnishes a particularly good example of the correspondence of actual observational fact with theoretical deduction. The elliptical nebulae and the central regions of the spiral nebulae, on the other hand, must be composed of minute particles of gas which do not condense into stars,

[1] *Op. cit.*, p. 337. [2] *Op. cit.*, p. 341

as is the case with the matter ejected from the nebular equator initially in the form of the spiral arms, due to the shrinkage of the nebula and its increase in rotation.

The ultimate picture that we reach for the moment is that of the sum total of those more or less regular nebulae, lying at somewhat regular distances from one another. Our stellar system, through the fact that its central region is all composed of stars, perhaps stands in a sort of senior relation to the others. Possibly the Magellanic Cloud is older still as it apparently is composed entirely of stars: it may be, however, that such spiral nebulae differ in their rate of development. If now we can imagine all these nebulae spread out, as it were, so that the matter composing them in its most tenuous gaseous form filled space so far as we can understand that term, we envisage a condition of things from which, given currents in, or movement of, the constituent molecules at a definite rate, the resulting phase would be the formation of distinct aggregations with masses comparable with those of the spiral nebulae. Such nebulae, acted on by tidal forces due to other nebulae or the general gravitational field of the universe, will give off matter at two antipodal points on the equator of the nebula. This ejected matter then takes the form of the

well-known symmetrical streamers or filaments which come off at opposite sides of so many nebulae, and are apparently more or less permanent features of the nebula showing them. The curves of the spiral arms in many nebulae take shapes which are not as yet amenable to law. Indeed while, on the one hand, the only motion in the spiral nebulae seems to be one of pure rotation, yet Jeans finds it 'almost impossible to explain pure rotation dynamically in terms of known forces, and we are led to the disconcerting, but almost inevitable conjecture, that the motions in the spiral nebulae must be governed by forces unknown to us'.[1]

In this very brief cosmogonic survey we turn now to the ordinary star with its far-reaching problems. The data to which we wish to draw attention are well illustrated by our own sun. The main suggestion is that its history, typical of so many corresponding objects, can be quite definitely related to the rest of the structure of the heavens. By the spectra of the stars, their surface temperatures can be ascertained, that of our sun being 5,750° C. But by various methods[2] it is also possible to determine the internal temperature of the stars. These methods follow

[1] *Op. cit.*, p. 351.

[2] For an account cf. J. H. Jeans, *op. cit.*, chap. iii

in part from considerations bearing upon what can be learned with regard to the 'effective temperature' of the stars, that is to say, the radiation emitted per second from every square centimetre of the star's surface. The figure comes out between 40 and 50 million degrees: this of course falls to a few thousand at the surface. Accordingly we must picture matter in the deep internal furnace of a star as being largely in a state of dissociation—free electrons and protons and atomic or highly ionized nuclei—all subject to the shattering play of quanta of high-frequency radiation generated by the intense temperatures. To what extent this is absolutely the case is still a matter of conjecture, giving rise to the view of large stars as with 'liquid' cores to the extent, say, of 5 per cent. of their radius, where the atoms may still retain some (1–3) rings of electrons, and 'jostle one another about like the molecules of a liquid',[1] or the smallest stars where electron-bare atomic nuclei may be packed with such density that a thimbleful of the Companion of Sirius would weigh a ton.[2] There is no question here of new chemical elements, but of ordinary matter under extra-

[1] J. H. Jeans, *Eos*, p. 30.

[2] The actual density of the Companion of Sirius is estimated at 60,000 times that of water (A. S. Eddington, *Stars and Atoms*, p. 50).

ordinary conditions, namely, with the atoms so shattered by high temperature that they can be packed in small compass. These possibilities in ordinary matter under new or extraordinary conditions warn us against setting limits to the potentialities in things on the basis of our present and past knowledge. We are dealing with what is to all intents and purposes an illimitably wonderful universe—illimitable in ever so many different kinds of ways.

Towards the surface of the star, from the centre outwards, the temperature falls. With the decrease in temperature, the atomic nuclei begin to pick up electrons, until at the surface doubly or trebly ionized atoms are encountered from which only a few of the outer electrons are missing, and in some cases complete atoms, and molecular structures. According to Jeans we may have 'a true picture of stellar structure by thinking of the layers of stellar matter as held up against gravitation by the incessant impact of a certain number of atomic nuclei or partially stripped atoms, the "molecular weight" of which is practically the same as that of the corresponding complete atoms, together with a far greater number of free electrons of standard "molecular weight" $\frac{1}{1840}$ or 0·00055, and a rather small number of "molecules" of radiation, the molecular weight

of which is negligibly small. The combined impacts of these three types of projectiles prevent the star from falling in under its own gravitational attraction'.[1] We can complete the picture by realizing that the nuclei are α-ray particles, the free electrons are β-ray particles, while the bulk of the radiation in most stars may be thought of as X-rays.[2] In fact a star is just an enormous X-ray apparatus. There is, then, from each star a great flow of radiation or radiant energy in the form of light and heat, passing from the far interior outwards. The surface temperature of the star is determined by the flow of radiation, and the latter depends on the rate at which energy is being generated in the internal furnace of the star.

Owing to the fact of great condensation of mass in the central regions of the stars, their outer layers are tenuous in comparison, even if it is there that the various elements are assuming their characteristic atomic form. And in these outer layers will probably be found only the lighter of such elements as the star contains, the heavier having sunk towards the centre. The earth, which has been formed from the outer-

[1] *Astronomy and Cosmogony*, p. 76.

[2] 'The ordinary radiation inside a star has about the same wave-length as the X-radiation of the laboratory' (J. H. Jeans, *op. cit.*, p. 83, cf. also p. 77)

most layers of the sun, will therefore not be likely to contain samples of the heaviest elements that the sun contains. That the sun and stars do contain atoms of higher, though not greatly higher, atomic weight than uranium is a distinctive thesis that was earlier maintained by Jeans with some insistency. In his last great work some hesitancy is apparent. 'It is entirely possible that the true atomic weights of stellar matter are all less than that of uranium, and that the atoms which undergo annihilation in the stars are merely isotopes of the heavier of the terrestrial elements.'[1]

The evidence for the enormous amount of energy pouring out from the stars raises the fundamental question of the origin of that energy. Recent investigations have shown that neither chemical heat nor gravitational energy are in any way adequate to account for the colossal emission of radiation by the sun, within such a period even as the history of the earth. The only source which remains open to consideration is subatomic. The life of a known radioactive substance like radium is, however, too short to maintain the supply for the period required, and corresponding difficulties with the other known radioactive substances rule out

[1] *Op. cit.*, p. 164.

their consideration in this connexion. Yet if the sun's mass is diminishing at the rate of about 4 million tons a second through the emission of radiation,[1] there must be some active supply, otherwise it could not have persisted during the 2,000 million years that we have taken as the age of the earth. By a process of exclusion of other possibilities, this source is now believed to lie in the actual annihilation of the matter composing the stars. Positive and negative charges—that is to say, protons and electrons[2]—are conceived, under the peculiar conditions in the internal furnace of the stars, as rushing together singly, neutralizing and thus simultaneously annihilating one another, the resulting single quantum of energy being set free as radiation. Each time a proton and electron are annihilated, a single splash or flash of radiant energy of exceedingly short wave-length,[3] and of total energy 0·0015 ergs, is produced. As it pursues its way through the interior of a star, its wave-length 'is con-

[1] J. H. Jeans, *op. cit.*, p. 108. Cf. also *Nature*, 121, 466: 'the sun radiates enough energy from each square inch of its surface to keep a 50 h.p. engine continually in action; still hotter stars may radiate as much as 30,000 h.p. per square inch'.

[2] Electrons subject to annihilation, which in any case is a rare process, must be such as are in orbital association with the nuclei of atoms, that is to say, 'bound', not 'free'.

[3] According to Jeans (*op. cit.*, p. 132), $1{\cdot}3 \times 10^{-13}$ cm.

tinually increased, or, to use the technical term, the radiation is continually softened. In time it becomes γ-radiation, then hard X-radiation, then soft X-radiation, and finally it emerges from the surface of the star as ordinary light and heat'.[1] In the case of an electron annihilated in free space, or in the transparent parts of some highly tenuous spiral or other extra-galactic nebulae, Jeans supposes that the short wave-length radiation—far shorter than anything that can be produced in the laboratory—undergoes no softening, and travels on until it is trapped by a Millikan as a 'cosmic ray', with its power to penetrate over five yards of lead, and its energy around 60 million volts. As yet we are only on the threshold of what may literally be vital discovery here.

At the present rate the annihilation of the whole mass of the sun would provide radiation for 15 million million years, which is roughly the period to which dynamical evidence points as being the age of the stars as a whole.[2] Accordingly, the original mass of any star is represented by the sum of the present mass and the mass of the previously emitted radiation. That is to say, all

[1] J. H. Jeans, *Eos*, p. 44.

[2] 'In general the annihilation of a gramme of matter must set free C^2, or 9×10^{20}, ergs of energy' (J. H. Jeans, *Astronomy and Cosmogony*, p. 109).

stars, except the youngest, must have been originally many times more massive than they are to-day, or more generally, old stars are less massive than young stars. But that also means that in default of any generally accepted scheme of cosmic rejuvenation, the universe of which we have knowledge to-day is, so far as mass is concerned, a reduced thing compared with what it was at any previous stage, by this continual loss through radiation. Our interpretation of it, even our present-day conception of it, is therefore certainly the merest skiagraph of Reality.

It is hardly necessary to add that of this annihilation of matter, there is as yet no direct evidence, and indeed 'there are some observational results which are hard to reconcile'[1] with it. Physicists are driven to the conclusion as the result of realizing the insufficiency of all the other explanations.

'The alternative', as Eddington has stated it, 'is to leave the stars in sleepy uniformity with no prospect of development or change until their lives come to an end. Something is needed to galvanize the scene into that activity, whether of progress or decay, in which we have so long believed. Rather desperately we seize on the one visible chance. The petrified system wakes. The ultimate particles one by one yield up their energy and

[1] A. S. Eddington, Thomas Hawksley Lecture, *Nature*, 123, p. 226 (1929).

pass out of existence. Their sacrifice is the life-force of the stars which now progress on their high adventure:

> Atoms or systems into ruin hurl'd,
> And now a bubble burst, and now a world.'[1]

Already in the inorganic, then, if this be true, we have a hint of the dominant cosmic theme of self-sacrifice, or at any rate, of sacrifice. It is, of course, just as easy to read too much into a process as to indulge in an account of it which is no more than a false simplification. Yet while it is suggested that protons and electrons are sacrificed so that thereby new energy is supplied, and the heat of a sun maintained, it is difficult to resist the surmise that the atoms, complete or incomplete, that remain, may be altered in some as yet indefinable respect in virtue of this surrender of their existence on the part of other atoms. Why should one atom or its constituents have a particular relation to other atoms so that in this figurative sense it works for other atoms and other atoms for it? Already a rapport—it might even be termed a sympathetic rapport—is established at this inorganic level. Out of the process, in the case of the battered survivors, come atoms that in a sense are settled in their constitution, and from some of them, could we but trace their story in the instance of our sun

[1] A. S. Eddington, *Stars and Atoms*, p. 112.

and earth and the subsequent development of life, have eventuated at long last elements that have gone to the constitution of a human brain. Has nothing qualitative happened to some atoms so that they have thus arrived ? It is, at any rate, the conceivability of such an evolution both of the very great and of the infinitely small and its implications, that can assist in providing significance from a man's cosmological background for his religious thinking. Nor is it in man to lay an embargo on yet future possibilities even of Atomic Evolution.

The stellar 'capital levy', the rate of which varies with the size of the contributor, tends in the passage of the ages to reduce the stars to a level, so far as their mass is concerned. It ought to be noted, however, that Shapley has recently suggested that 'a part of the mass lost by a star through radiation is replaced by the meteoric infall'. He offers evidence indicating that there are 'enormous quantities of secondary bodies around stars', and goes on to maintain that 'extrapolating from the earth's daily intake of some twenty or thirty millions of naked-eye shooting stars, it is found that the sun absorbs at least a million million meteors a second, or more than a thousand tons of iron, magnesium, silicon, and oxygen, if the average mass of

a meteor is of the order of only one milligram'.[1] In the case of the sun this degree of repletion would be scarcely appreciable, although it is probable that the figures are an understatement, but in the case of stars in dark nebulous clouds, it might be an element of considerable importance in connexion with the retardation of the radioactive degradation of their energy.

The rate of liberation of energy by the stars varies, since it is apparently dependent neither on temperature nor density conditions, but is of that 'spontaneous' character that we associate with radioactive process. In keeping with this it is found that the stars which radiate most energetically are the most massive, that is to say, the youngest. There is thus a direct relation between mass and luminosity, but not between internal temperature or density and luminosity. Since from the earth to-day there is comparatively little generation of energy, and we have seen it to be probable that the earth was formed from the outermost layers of the sun, the atoms in these outermost layers cannot be a fair sample of the sun as a whole. On such a supposition Jeans bases his idea that 'whatever mixture of elements may constitute the sun, the heavier elements are likely to sink to its far interior, so

[1] *Nature*, 122, p. 484 (29 Sept. 1928).

that the atoms in its outer layers are selected for their light atomic weight',[1] and the capacity for the generation of radiation will therefore lie in those heavier elements in the far interior. Those heavier elements will be the first to disappear as the star ages, owing to the fact that they are presumably most radioactive.

What, however, do we really know in the last resort as to the character and destiny of the universe from the larger point of view? We have seen that, so far as we understand the universe, it proves to be a realm of order and, on the whole, of progressive developmental activity. At no point does it put us to lasting intellectual confusion, even if our belief in its absolutely pervasive orderliness is, compared with the relatively meagre area of actual demonstration, a gigantic act of faith which science, however, persistently succeeds in confirming. And the alternative to this is not at all the reintroduction of any conception of miracle, at least as that was understood by previous generations. It is rather the recognition that the ultimate character of the process is more baffling, more awe-inspiring, and yet more satisfying than the most crude acceptance of miracle on older views could have desired. Just in proportion as we realize that all

[1] *Op. cit.*, p. 130.

natural laws are simplifications of the phenomena they are supposed to subtend, and in that measure can never be absolutely exact statements, and that, since we are dealing with a developing process, they will sometimes stand in need of restatement at sufficiently long successive stages of it, and can never, on the basis of any human experience, be dogmatically stated to be of absolutely universal validity, do we begin to understand that it is just all this—the tendency towards law—seen as a tendency by us because of the limitations of our human minds—that demands explanation. The activity takes the form of a process of which we can see comparatively little, and which may, for all we know, merely be a phase of some still more inclusive process. It is none the less a process the unity of which is profoundly more impressive than its uniformity of procedure. In this direction many modern discoveries seem to point. The recent demonstration that light-rays—typical waves—behave like corpuscles, whilst electrons—hitherto conceived as typical corpuscles—act like waves, is of this character. As also the fact, in terms of Eddington's latest theoretical achievement, that the 'exclusion' and 'repulsion' principles in electronic action describe very much the same kind of effect or interaction,

and may be at bottom the same thing. The last and possibly most impressive of these achievements is Einstein's Unitary Field Theory, under which is attempted the reduction of the explanation of the fields of gravitation and of electromagnetism to a single formula. This is a further simplification along the lines of his Theory of Relativity, by which he had already reduced the laws governing space, time, and gravitation to one formula. As the result of his most recent work it becomes evident that the force which moves electrons in their ellipses round the nuclei of atoms is the same as that which moves the planets round the sun, and conveys the light and heat from the latter to our earth. In view of the rapidly growing wonder of the process itself, as it becomes better understood, it is increasingly apparent that nothing is to be gained by efforts, almost certainly illusory, to indicate the possible centrality or uniqueness of our solar system in the scheme of things, thus in a sense isolating it, and in that measure tending to withdraw attention from what is really the sublime and awe-inspiring Whole.

Yet once again it is a universe that, rightly understood, gives no sense of vacancy or void.

'I believe', says Eddington in a thought-provoking passage, 'that, reasoning from the tailing off of the

nebulae, we are in a position to make an estimate of the amount of matter remaining unaggregated in space. An ordinary region where there is no observable nebulosity is the highest vacuum existing—within the limits of the stellar system at least—but there still remains about *one atom in every cubic inch*. It depends on our point of view whether we regard this as an amazing fullness or an amazing emptiness of space. Perhaps it is the fullness that impresses us most. The atom can find no place of real solitude within the system of the stars; wherever it goes it can nod to a colleague not more than an inch away.' [1]

There is, then, no such thing as empty space. Had we but eyes to see, how different the world would be! In fact the system of stars is floating in an ocean—moving in a cosmic cloud or medium of interstellar space—'not merely an ocean of space, not merely an ocean of ether, but an ocean that is so far material that one atom or thereabouts [2] occurs in each cubic inch'.[3] Was Bernard of Cluny, then, intuiting Reality when he sang:

> Thou hast no shore, fair ocean!
> Thou hast no time, bright day![4]

We may, however, reply at once to our question as to what we know of the character and

[1] *Stars and Atoms*, pp. 64, 65.
[2] Believed to be sodium and ionized calcium.
[3] A. S. Eddington, *op. cit.*, p. 67.
[4] From his hymn, 'For thee, O dear, dear country'.

destiny of the universe that it appears to be of the nature of a one-way affair. The law of entropy, subsumed in the second law of thermodynamics,[1] appears to be of universal application, with the possible exception of life, where its operation is at any rate retarded. Everything seems to be moving in the direction of degradation of energy: from the point of view of astrophysics, everything is dissolving into radiation. The final picture is that of a state of maximum entropy, where every atom that is able to do so has dissolved away into radiation. As to whether at any point or in any way energy is being upliftingly transformed into matter, we do not know. A cyclic view of things demands such a phase, and an interpretation of this character will incessantly be sought by those who believe in the ultimacy of mechanics, and awaited unconcernedly by others.

Yet it is doubtful if any of the schemes of cosmic rejuvenation—of the winding up of the down-running clock—that have been offered to date, are really satisfactory. One of the most recent has been propounded by R. A. Millikan, and demands careful attention.[2] He affirms that there

[1] In the form of the Law of Clausius it states that in any isolated system, the entropy, or degradation of energy, tends to a maximum.

[2] Outlined in his Messel Memorial Address 'Available

is experimental proof that the nuclear combination which produces the 'cosmic rays' does not take place in the stars at all, but results from the condensation, through some unknown mechanism, of radiant heat, at places of low pressure where the temperature is close to the absolute zero, i.e. in interstellar or intergalactic space. This gives accordingly a cycle working between the two extremes of continuous atomic annihilation in the internal furnaces of the stars, and continuous atomic creation in the regions of absolute zero between the stars. In answer to the question as to why the primordial positive and negative electrons which go to build up the common elements have not been used up long ago, he replies 'that out in the depths of space where we actually observe through the cosmic rays helium, oxygen, and silicon being continually formed out of positive and negative electrons, there too these positive and negative electrons are also being continually replenished through the conversion back into them under the conditions of zero temperatures and densities existing there, of the radiation continually pouring out into space from the stars'.

Energy' and developed in *Physical Review* for October 1928. Cf. *Nature*, 122, pp. 555, 556 (6 Oct. 1928); and 122, pp. 699, 714 (3 Nov. 1928).

The suggested theory has, however, been subjected to the inevitable criticism that it clashes with the second law of thermodynamics. 'Indeed, it is easy', says one distinguished critic, 'to find the exact spot at which Millikan's concept comes into conflict with the second law of thermodynamics; it is that we cannot have protons and electrons transformed into radiation at a high temperature and then have the process reversed at a lower temperature.'[1] This, however, assumes the absolute validity of the second law of thermodynamics, which may be the very question at issue. 'May be', because there are hardly data in the theoretical part of the Millikan determinations, and certainly nothing in the experimental, to render it invalid.

In any discussion of the nature of the universe, we quickly reach the limits of our interpretations, at any rate for the time being. Expression has been given to this realization again and again by workers who have moved to the confines of their particular field of investigation.

'Each failure to explain the spiral arms,' says Jeans, 'makes it more and more difficult to resist a suspicion that the spiral nebulae are the seat of types of forces entirely unknown to us, forces which may possibly

[1] Cf. J. H. Jeans, 'The Physics of the Universe', *Nature*, 122, p. 699; also J. A. Gray, *Nature*, 123, p. 447.

express novel and unsuspected metric properties of space. The type of conjecture which presents itself, somewhat insistently, is that the centres of the nebulae are of the nature of "singular points", at which matter is poured into our universe from some other, and entirely extraneous, spatial dimension, so that, to a denizen of our universe, they appear as points at which matter is being continually created.' [1]

Perhaps this reads like giving up the problem, and it certainly comes somewhat inconsistently from such a whole-hearted believer in the absolute validity of the law of entropy. Apparently, while holding true of what is 'poured into our universe', that law does not hold of the source of the energy or matter. We may have no doubt that time will disclose some perfectly natural explanation of the spiral arms, but we may be just as certain that other data will then loom up which will make it even more 'difficult to resist a suspicion' that man is in the presence of forces 'entirely unknown' to him, which have their origin in 'some other, and entirely extraneous, dimension'.

If we wish to form a picture of the process of the creation of atoms whether continuous or as a single event—much more probably the former—we may imagine with Jeans, 'radiant energy of any wave-length less than $1{\cdot}3 \times 10^{-13}$ cm. being

[1] *Astronomy and Cosmogony*, p. 352.

poured into empty space'; and 'crystallizing' into electrons and protons, thereafter to form atoms.[1] Indeed, in one striking passage he seems to put modern cosmogony strangely in line with some old beliefs.

'There is no longer', he says, 'any evidence that any star is more than about 10^{13} years old, and, indeed, a good many lines of evidence converge in indicating ages of the order of from five to ten million million years for the main mass of the stars, these ages being measured from the time at which the stars first condensed out of the parent nebula. The atoms of the parent nebula must have ages which are at least of the same order of magnitude, and as all the nebulae in the sky may be of the same age, there is no reason against supposing that the whole universe may have been created, or come into being, at the same instant.' [2]

The fact, however, that the nebulae and stars show very different conditions of size and substance makes it fairly clear that creation was no solitary momentary affair, but is rather of the nature of a continuous process. Simultaneity of celestial creation must have meant far greater uniformity of size and distribution than we observe to-day. A regularly patterned universe like a Volvox[3] colony is a conceivable affair,

[1] 'The Physics of the Universe', *Nature*, 122, p. 698 (1928).

[2] *Astronomy and Cosmogony*, p. 373.

[3] Volvox globator is a minute flagellate colonial protozoon, the vegetative cells of which are set at somewhat regular

containing within it, and contained within, the limits of space, time, and matter that we see to-day. What we find, however, is a great variety of disposition and content, which suggests a process of continuous creation.

As the whole conception of time is meaningless apart from some possibility of measuring its passage, it follows that no space-time experience is possible apart from the materialization of energy in some form or another. Yet what is Energy, according to the physicist? Something which 'no man hath seen or can see at any time', a mathematical expression which is invariant in respect to certain transformations, yet apparently not invariant in General Relativity, so that its importance in that scheme of things is very much diminished. Energy is $\frac{1}{2} mv^2$, and is described in various forms, potential and kinetic, chemical, heat, and so on, and each form is measured in terms of the work it can do. Yet we do not know that to which the formulae relate: as has been admirably expounded by Eddington, 'the whole subject-matter of exact science consists of pointer-readings and similar indications'.[1] Mathematical equations are apparently the only

intervals in the outer gelatinous framework of the spherical colony, while daughter colonies may be seen moving about freely in the interior of the sphere.

[1] *The Nature of the Physical World*, p. 252.

things we know. We can make our descriptions more picturesque by talking of matter and energy and so forth, but our real knowledge is limited to pointer-readings. Pushing back, then, we seem to come up at some point or another, sooner or later, against some World Ground or Infinite Invisible Source of Energy—in this case in the form of radiant energy, which first becomes manifested in the primitive nebular matter. In this form it has minimal wave-length, and may be thought of as condensing or crystallizing into protons and electrons, and so into atoms. But of the ultimate manifestation or directing control or provision of that Energy, who can tell? If we say that the Whole is simply an idea in the human mind, it is at least possible that the Whole plus that human mind is an idea in some still greater Mind—greater because it has the power of making the Whole an actuality.

Accordingly, while holding for the time being to the one-way view so far as the physical aspects of the universe are concerned, we maintain at the same time that this picture of the universal degradation of energy on the physical side of the universe does not necessarily involve a corresponding degradation on the spiritual side—evinced in the objective fact that the process looks as if it were moving towards some worthy end

—and may be the inconceivable cost of such spiritual upbuilding. If we represent the 2,000 million years of the earth's history by a day of 24 hours, then man's existence—estimating this period conservatively at 400,000 years—represents but 17 seconds of that day. Only within 1/80 of the last second has he had any seriously supportable outlook on the universe as it is. Only comparatively recently has he begun to realize that even if the earth is *his* earth, still it is part of a universe that may claim *him*. Man is at home on the earth but hardly as yet in the universe, and yet it is to it that he belongs—to the dynamic *uni*verse that has replaced the static *multi*verses of our fathers. Of this larger citizenship and its demands he has hardly begun even to think. And the possible importance of this is felt in great measure when we consider the overwhelming cost or attendant circumstances under which he has come into existence. Life, as we know it, cannot exist on any of the stars because of their great heat, or the nebulae because of their saturation with radiation. It is only on planets where the cooling-down process has permitted the condensation of ternary and quaternary chemical substances that life could find a nurturing lodgement. Yet the outstanding fact is that at this terrific cost of

suns and planets and forms of life, subhuman and human, there have eventuated beings that can weigh the stars, can tell them by name or number, can fathom the secrets of organic development, and, when in the sheer fatigue of the solemnizing enumeration of such 'works'—'Thy thoughts, O God'—they fall into a reverie and slumber, can say with the old Psalmist from the heart, 'When I awake, I am still with Thee'.[1]

[1] Ps. 139, v. 18.

LECTURE II

NATURE: HUMAN

THE history of the evolutionary process, culminating as it does to-day in Man, suggests in that measure the development of spiritual beings as the possible aim and completion of the process, even if the final stage is far from having been reached. Man at any rate is the highest organism upon our planet both in regard to his all-round excellence of integration and differentiation, and because he has undoubtedly the best brain of any form of life. In virtue of this and because of the associated spiritual capacity, he is not merely the masterpiece of the process, but also its only interpreter. Man alone, of all living organisms, knows of a past and hopes for a future. If the palaeontological succession of vertebrates be considered as a means for the production and appearance of Man, then he gives meaning to that succession, and a suggestion of infinite worth is afforded by contemplation of the way by which he has come—by the cost of his production. The implicit rationality of the process becomes explicit in him.

Like every form of life, Man has had a history, but no history has been so romantic. And it is only to-day in process of being written, because

it is only now being really discovered and understood. There is a very real sense in which Man is synthetic of all the previous representative types of life—a physical heir to all the ages. They have almost all gone to his making in some respect or another. Thus, for example, Dr. W. K. Gregory has recently shown [1] how in the case of the human head, the gradual development of the bones of the skull, through ten well-marked structural stages from the fish upwards, is punctuated at every new level by the incorporation of some characteristic gain. The general plan, as also the twenty-eight normal bones of Man's skull, came from bones present in the skull of certain primitive lobe-finned and air-breathing fishes from the Lower Devonian. From the pioneering amphibians he derived the beginnings of his ear-drum. The more primitive reptiles retained for him, with improvements, those partial solutions of the problems involved in emergence from the water that had been worked out by the early amphibians, whilst to the more mammal-like reptiles he owes the rudiments of his temporal fossa and zygomatic arch, together with the dominance of the superior maxilla.

[1] 'The Palaeomorphology of the Human Head', *The Quarterly Review of Biology*, vol. ii, No. 2. Cf. also his *Our Face from Fish to Man.*

With the advent of increased resemblance to mammalian characters in the higher reptilian types, Man finds himself indebted to these last for the dominance of the inferior maxillary or dentary of the lower jaw, as for the differentiation of his teeth into incisors, canines, premolars, and molars. The earliest mammals simplified his masticatory apparatus, and by the reduction and elimination of other osseous elements, prepared the way for the further reduction in the bony scaffolding of the face. The first Primates laid the foundations of the dominance for Man of sight over smell or hearing, and introduced the many arboreal adaptations that in later forms were readapted to life upon the ground. The early anthropoids showed that shortening and deepening of the face, indicating the provenance of an enlarged brain and cranium, on account of which, as has been wittily remarked, men walk the earth to-day with long faces and swelled heads. There is, indeed, a continuity of movement that has included all these forms, and thereafter left them in a measure to themselves, as it pushed on in the direction of what would eventually be Man. The remarkable fact is, as Gregory observes, that all these various advances in skull structure 'were dependent upon improvements in the brain itself, upon shiftings and enlarge-

ments of the parts containing the sense organs, upon modifications of the jaws and teeth, accompanying or accompanied by changes of habits'.[1] Yet in spite of this amazing incorporation of much that was distinctive of those lower forms, Man remains curiously unique in his minimum of specialization, and so in his great capacity and potentiality for the expression of a still fuller life. And this means that in Man and in human society, the purpose of the Whole, if purpose there be, must come most clearly to light.

Even in its later and distinctively humanoid phases, the long story goes back to the Eocene days (Early Tertiary), when we get the first hint of that highest of the mammalian orders, the Primates. They are and were mainly arboreal, entirely hairy, with five digits on fore and hind limb provided with flat nails, and with many other characteristics of skull, teeth, and brain differentiating them from the synthetic group of the now extinct Creodonts. From this original Primate stock there diverged in the Eocene, first the New World monkeys comprising the Hapalidae (Marmosets) and Cebidae, or American monkeys proper: at a later stage the Old World monkeys and apes branched off,

[1] *Op. cit.*, p. 277.

first represented by the Old World monkeys and baboons (Cercopithecidae), and in the Oligocene by the man-like apes (Simiidae), comprising the Gibbon, together with, later, the Gorilla, Orang-utan, and Chimpanzee.

Of Man's solidarity, particularly with the Simiidae, and so with the rest of organic creation, anatomically and physiologically, there is no doubt. Blood relationship is no longer a metaphor: on the basis of Nuttall's tests,[1] it is a fact of definitely calculable degree. The kinship manifests itself in the most unexpected ways. For example, W. L. Straus,[2] in a study of the embryological changes undergone by the human foot, has found clear evidence of its evolution from a type that has been arboreal and prehensile. He states that in the foetus of the third month the great toe or hallux is 'highly divergent, and somewhat opposable', and that the tarsus is short and the phalanges are long, as in all arboreal Primates. He finds that at an early stage of development, Primates have feet of a common type, and from this common type specialized forms are produced by divergent growth. The

[1] George H. F. Nuttall, *Blood Immunity and Blood Relationship, A Demonstration of certain Blood Relationships amongst Animals by means of the Precipitin Test for Blood.*

[2] Vol. xix of *Contributions to Embryology* (Publication No. 380, Carnegie Institution of Washington D.C.).

foot of the human foetus is 'in many, if not in most respects, not unlike that possessed by the adult gorilla, although in some points even more primitive than that of the largest of the anthropoid apes. Most of these ancestral characters are to a great extent lost before birth; many, however, persist in adult man in a vestigial condition'.[1] And so, to mention one detail, most of us wear out our shoes more rapidly on the outer than on the inner edge of the sole. The arboreal phase in ancestry is further indicated by other definite features in structure, e.g. the proportions of the limbs.[2] According to Sir Arthur Keith, 'in the gorilla, which the majority of authorities regard as manifesting a greater structural resemblance to man than any other living form, there is found as wide a range of cranial proportions as is found in any mixed group of human skulls . . .'[3] The physical resemblances are so uncannily close that the time cannot be far off when it will be rightly felt that to shoot a gorilla in cold blood is almost murder. There is, in fact, no structural feature in the brain of Man that may not be compara-

[1] p. 132.

[2] Cf. H. F. Osborn, 'The Influence of Bodily Locomotion in separating Man from the Monkeys and Apes' (*Scientific Monthly*, May 1928).

[3] *Nature*, 120, p. 914 (1927).

tively matched in the chimpanzee or gorilla amongst the anthropoid apes. Again, the development of the macula lutea ('yellow spot') in the retina of Man and the monkeys alike induced certain changes with regard to the cerebral cortex, which have provided a power of appreciation of the world, particularly in the case of Man, such as no other animals have.[1]

The physical differences, then, between Man and the anthropoid apes are not very profound, although the shape of the skull, the small size of the canine teeth, and the normal lack of opposability of the great toe in Man are noteworthy. Nevertheless Man *is* apart, and differs from all the Simiidae in a certain spacious way. His brain is absolutely as well as relatively much greater than in all the apes, even if, as yet, we have no technique sufficiently refined to reveal differences in the fine structure in any way corresponding to the known differences in mental grasp. In particular the cerebral hemispheres are very greatly developed both in bulk and the complexity of the convolutions. According to the latest estimate there are some 14,000 million neurons in the grey matter (cortex) of a European brain of average size. When in

[1] G. Elliot Smith, 'The New Vision', *Nature*, 121, p. 680 (1928).

addition we realize that each neuron may have as many as 100 nerve fibres (dendrites and axone) connected with it, we are surely in the presence of the most complex organic structure known to man. Therewith *in some way* are associated his characteristic powers of forming general ideas, of fashioning tools in order to make tools, his capacity for speech, his vivid self-consciousness, and his strong social sense and submission to the principles of government. As for conscience and his moral sense, they are the developed aspects of that spiritual aspect or element of his nature which constitutes the real, initiating, and responsive Man, and yet is not entirely unconnected with the stages that led up to Man. It is now very generally accepted that Man has ascended from a primitive anthropoid form that at that arboreal stage bore a closer resemblance to the chimpanzee than to modern Man, but was less specialized in ape-like habits than the orang. The principal question in dispute to-day is how long a period has elapsed since Man became typically terrestrial.

Of great interest in this connexion are the remains found in 1924 in a dolomite (limestone) cliff at Buxton, Bechuanaland. Popularly known as the Taungs skull, the fossil was invested with the generic name of *Australopithecus africanus* by Professor R. A. Dart, who first described it.

It represents a form on the anthropoid side of the dividing line, yet more human than any known anthropoid type, past or present. The remains are far from complete, being in part fossilized bone, and in part casts of the brain and bones impressed on the limestone. Sufficient, however, is preserved to show that the creature was unable to talk, but there are indications of an advance in brain structure which mark it out as the most highly developed anthropoid form known. W. J. Sollas shows,[1] as Dart had already said, that the Taungs skull is generically distinct from all known Primates, and the distinctive characters are precisely those by which it approaches Man. Exact determination of the age of the deposits, with any reasonable assurance that the remains were contemporaneous with it, would be of considerable value in helping to settle the disputed point to which reference has been made above.

Adopting a conservative point of view, as under the circumstances is undoubtedly the wisest procedure, and accepting an Early Pleistocene determination for the deposits in Java in which the remains known as *Pithecanthropus erectus* were found, we may hold that man has been traced back

[1] 'On a Sagittal Section of the Skull of "Australopithecus africanus",' *Quart. Journ. Geolog. Soc.*, lxxxii, pt. I, 1926.

to the beginning of that era, a point in time much nearer 400,004 B.C. than the Ussherian days of creation, placed with that precision and exactness of detail which no later generations will ever equal, in this particular reference somewhere in the early autumn of 4004 B.C.[1] Admission of an earlier existence is based more on theoretically justifiable grounds—justifiable so far as they go—and the acceptance as artifacts of such flint objects as the 'rostro-carinates' from the sub-Red Crag of East Anglia, than on any unequivocal Pliocene human remains, or other equally convincing objective evidence. In view

[1] Cf. e.g. these three pronouncements from the 'Collected Works of the Rev. Dr. John Lightfoot (1602–75), Master of Catharine Hall and Vice-Chancellor of the University of Cambridge'.

'That the world was made at equinox, all grant—but differ at which, whether about the eleventh of March, or twelfth of September; to me in September, without all doubt' (vii. 372), the reason for his certainty on this point being, as he indicates in another place, that apples would be ripe in September.

'Man created by The Trinity about the third hour of the day, or nine of the clock in the morning.' (From his *Few and New Observations upon The Book of Genesis*, under chap. I, v. 26; ii. 335.)

'He was created about nine o'clock in the morning, fell about noon. Christ was promised about three o'clock in the afternoon.' (From the Index, under *Adam*, referring to vol. vii. 376, 377.)

It is interesting to note that man, 'according to the astrologers of Babylon, first appeared nearly half a million years ago' (Arthur Holmes, *The Age of the Earth*, p. 5).

of the prominence given to the supposed Pliocene antiquity of the flint implements from the Foxhall layers in the Red Crag of East Anglia, it is important to note that their discoverer, Mr. J. Reid Moir, now follows the best geological authority in referring the Red Crag 'to the beginning of Quaternary times'.[1] The degree of individual subjectivity that enters into the judgements passed on 'rostro-carinates' and all eolithic specimens is not easily assessed, but it is very high. Further, we cannot afford to neglect the warnings of authorities like C. E. Vulliamy and Hazzledine Warren to the effect that the 'rostro-carinate', in its most ideal form, 'is freely produced by nature, at all periods and in various materials',[2] and it is difficult to understand why the humanoid form of this period should have gone to the immense trouble of making the somewhat inferior implements ascribed to him, when admittedly better ones of natural origin lay around him. On the other hand, from Pliocene and Miocene alike have come down numerous anthropoid remains, for the most part teeth and fragments of jaws. How many, if any, of these forms may have stood close to the direct line of descent it is still impossible to say, yet

[1] J. Reid Moir, *The Antiquity of Man in East Anglia*, p. 19; cf. also p. 32.

[2] *Man*, Jan. 1929, p. 2.

expert study by W. K. Gregory and M. Hellman of New York [1] and Professor D. M. S. Watson of London, agrees in placing the *Dryopithecus* genus definitely nearer the common stem form than any of the modern anthropoids, to which in any case it is ancestral. The principal large-scale features differentiating Man from the presumed arboreal ancestral form are just such as would take place in the adaptation of an arboreal to a terrestrial form of the type—e.g. reduction in the length of the arms, greater straightness and increase in the length of the legs, and so on. Characters like the broad shoulders and shallow chest remain to attest the earlier way of life, and remain because they are serviceable even on the definitely terrestrial level. It then becomes probable that the marked characteristics of *Pithecanthropus* and Neanderthal man, e.g. the supra-orbital ridges in both, and the slightly curved femur of the latter, came about by an evolution parallel to that of the gorilla.

The growing tendency to look for the cradle of Mankind ever farther to the East has received added justification by the discovery (1925) of

[1] *Anthropological Papers of the American Museum of Natural History*, vol. xxviii, pt. I: 'The Dentition of Dryopithecus and the Origin of Man.'

a fragment of a skull of the Neanderthal type in a cave deposit near Tiberias on the western shore of the Lake of Galilee in Palestine, and (1928) of further fragments of the same human type in the Cave of Shukbah in Western Judaea.[1] Still more important in this connexion were the discoveries in 1921 and 1926 of a lower premolar and two molars (upper and lower) at Ch'ou K'ou Tien, twenty-five miles from Peking, in beds determined to be of Lower Quaternary Age. In the summer of 1928 an even richer discovery of portions of skulls, about a score of teeth, and various bones was made in the same locality, and it is possible that this 'Peking Man', with his characteristically anthropoid jaw, may yet prove to be the oldest human fossil known. From parts of the calvaria of both immature and adult individuals 'partly exposed in various blocks of travertine', Dr. Davidson Black deduces that 'in spite of the archaic structure of its lower facial region, *Sinanthropus* was a large-brained form, probably having a cranial capacity well within the range of normal variation of this character in the modern genus *Homo*'.[2] As the result of the work of the Central

[1] *Report of British Association for the Advancement of Science*, 1928, p. 594.

[2] 'Preliminary Note on Additional Sinanthropus material discovered in Chou Kou Tien during 1928' (Davidson Black,

Asiatic Expedition under Dr. Roy Chapman Andrews (1922, 1923, 1925), instigated by the prophetic insight of Dr. Henry Fairfield Osborn,[1] the whole subject of the climatic controls operating at the time has been illuminated by a study of their effects in developing the land surface.[2] During the period of the Pleistocene glaciation in Europe and North America, Central Asia experienced somewhat different conditions. There are indications of a corresponding fall of temperature, but the distribution of precipitation did not favour the development of a continental ice-field. Hence although the plains of Mongolia had already practically attained their present altitude, it was only on the still higher mountain ranges that snow collected in any quantity. As a result, the local glaciation never reached the dimensions of a true ice-cap, but was definitely restricted to the Alpine valley type. The work of the geologists of the Central Asiatic Expedition in the Altai Mountains confirms the observations of many Russian explorers in this field.

Peking Union Medical College, Peking, vol. viii, No. 1, of *Bull. Geolog. Soc. of China*).

[1] In this connexion reference must also be made to the work of Dr. W. D. Matthew.

[2] Cf. C. P. Berkey and F. K. Morris, *The Geology of Mongolia*. I am indebted to Prof. G. B. Barbour for much helpful direction at this point.

Though there is evidence of at least two distinct glacial advances, data are insufficient, at any rate as yet, to permit of any exact correlation between them and the three main stages recognized in the West.

In attempting to date the early appearances of prehistoric man in Eastern Asia it is important to note that the traces of primitive cultures in the Gobi region have not, so far, been found associated with Quarternary deposits whose exact age is readily determinable. Correlation is only possible by a careful study of the sequence of physiographical stages by which the present land surface has evolved. In Northern China the loess constitutes an important horizon in dating the early cultures. The Palaeolithic foyers discovered by Licent and Teilhard occur at the base of the loess,[1] whereas the late Neolithic cultures were separated from the older horizon by the time required for the accumulation of the wind-blown loess, the erosive stage which followed, and another epoch of deposition. In Mongolia loess is a rarity; in fact the loess of China is no more than a concentration of the finer dust sifted out by the wind action from the

[1] Archives de l'Institut de Paléontologie humaine, Mémoire 4: *Le Paléolithique de la Chine*, par M. Boule, H. Breuil, E. Licent et P. Teilhard.

late basin sediments of the Gobi. Hence, in the Gobi, this useful time index fails us. But it is probable that with the help of such characteristic fossils as *Rhinoceros tichorinus*, supported by a careful physiographical study of the basin margins, some age relationship can be established between the ice-advances noted in the Altai and the period of loess accumulation.

Undoubtedly it is only a question of time till evidence of the Lower Palaeolithic stages of human development is forthcoming in Eastern Asia. From this fertile womb of the East—perhaps, as Davidson Black and others suggest, in one of the great interior basins north-east of Tibet—issued at long intervals successive racial types, often constituting in their development an advance upon preceding types, which were thus forced out in every direction by the fitter successor. The migrations can be traced by the cultures of the migrants. In the East they so far seem to be always in advance of the European facies at corresponding periods. Indeed cultures that appear in quite definite chronological series in the West owing to the delay in reaching there, seem to co-exist and intermingle as the result of the more rapid development at the source.

The changes initiated from the Eocene onwards through the progressive elevation and

dessication of the vast Central Asiatic region, as traced by Davidson Black,[1] would all tend to promote the incipient cleavage between the homosimian and purely anthropoid stocks. The latter, with their relatively earlier maturity in individual development and consequent static relationship to environment, were not so fitted to adapt themselves to change, and consequently tended to follow their particular environment (the remnants of afforested areas) wherever these were conserved. In consequence, we have the present-day distinctive distribution of the anthropoids, fossil and modern, as a whole towards the extremities of lines radiating south, west, and east from the central area of origin. A similar distributary movement occurred in the case of Man, except that he, so to speak, also stood his ground at the focus of origin. The extended infancy and childhood in his case, involving a longer phase of educability through retardation of the closing of the sutures of the skull and increase of cerebral content, meant greater ability to profit by experience and so success in adaptation to the changes from forest to open country. We may well follow Dr. Osborn in maintaining

[1] Cf. 'Tertiary Man in Asia; the Chou Kou Tien Discovery', *Science*, vol. lxiv, pp. 586, 587 (1926), and 'Asia and the Dispersal of the Primates', *Bull. Geol. Soc. China*, vol. iv, No. 2, pp. 133–83 (1925).

that 'all precocious intelligence and early civilization in mankind were fostered in open regions where the food supply is scarce and impossible to obtain without individual effort and resourcefulness',[1] and that consequently the relatively dry plateaus of Central Asia correspond to the conditions required at this particular period. If group after group of successively higher types evolved in this central region, it is only natural to suppose that they would push the previous lower types out before them in all directions, east, south, and west. The distribution of the most primitive surviving types (e.g. the modern Australian) as also of the fossil remains of man (e.g. *Pithecanthropus erectus*, Neanderthal Man) is found to lie on the periphery of the past and present continuous land connexions in relation to the presumed centre, in such a degree as to suggest that the above interpretation of events must contain at any rate part of the truth.

The recent noteworthy discovery at Elmenteita in Kenya Colony, East Africa, by L. S. B. Leakey, of what are apparently two Aurignacian skeletons (*H. sapiens*) has revived interest in the Oldoway remains, whose solitariness had hitherto rather tended to their neglect. It also serves to add weight to the dictum of the master-mind to the

[1] *Man Rises to Parnassus*, p. 165.

effect that it is 'probable that Africa was formerly inhabited by extinct apes closely allied to the gorilla and chimpanzee; and as these two species are now man's nearest allies, it is somewhat more probable that our early progenitors lived on the African continent than elsewhere'.[1] The fact that these skeletons, associated with what are distinctively Aurignacian implements, except for the material (obsidian), were found *beneath* a layer characterized by typical Mousterian implements, suggests that the makers of these tools came from Europe—a social penetration amongst an indigenous Aurignacian culture —and adds fresh interest to the Rhodesian skull (1921) as a possible later modification of a typical Neanderthaler. At the same time there is nothing in these discoveries that inherently militates against the theory of an initially Asiatic centre of origin, as the passage through a Mesopotamia, or even Arabia, very different in physical character from the areas that bear these names to-day, could have presented no serious difficulties. In fact the peculiar interest of the two skeletons referred to is that, in the opinion of Professor Reck of Berlin, who discovered the Oldoway skeleton in Tanganyika in 1914, neither of them shows any of the characters of

[1] Charles Darwin, *The Descent of Man*, p. 240.

a present-day African type, but are distinctively Asiatic, and that even to the burial cult.

In any attempt to characterize human nature, and establish a case for its progressive, not to say its salvable, capability, as against the idea of its fixity, it is important to note that there has been a very great range of physical advance—of change in bodily form and proportions—in the known types, represented sometimes by individuals only as yet, which, if they do not actually punctuate, still have some sort of relation to, different stages in an evolution. Thus there is *Pithecanthropus erectus* from the Early Pleistocene of Java, who was so much simian that he has only comparatively recently been wholeheartedly welcomed into the human family, and given the right hand of fellowship on the introduction of Professor Elliot Smith, who showed that this much debated type could just speak.

'The endocranial cast of *Pithecanthropus* reveals a localized and precocious expansion of those areas of the brain which we associate with the power of articulate speech, that is, ability to appreciate, in a far greater degree than other animals are capable of, the auditory symbolism of sounds, and to reproduce them as a means of communication with its fellows, not merely as signals expressive of emotional states, such as most animals can impress upon one another, but also as the means for transmitting information and ideas, and attaining

the communion of knowledge and belief that is Man's exclusive prerogative.' [1]

There seems little doubt now that he was human except in average cubic brain capacity. And this in the end resolves itself simply into a matter of deciding at what point we are going to draw a certain line—as if we had to determine at what exact point a boy becomes a young man. There is also the famous jaw of *Homo heidelbergensis*, from Early Pleistocene sands at Mauer near Heidelberg. Betraying a remarkable degree of generalization in all its characters, its very uniqueness made it a dangerous jumping-off point for all manner of theorizing. It is therefore something of a relief to learn that Dr. Wilhelm Freudenberg has collected further fossil human remains from the same bed, including a tibia 'short and very stout, with an inward twist, and in many ways like that of a big gorilla',[2] which he ascribes to the same species (*Homo heidelbergensis*). The fuller description of this and other fragments—'a femur . . . also very gorilla-like', 'a second metatarsal . . . curved as in a chimpanzee', and a 'first metacarpal . . . twice as large as that of a modern man'—and other remains more directly ascribed by their discoverer to

[1] *The Evolution of Man*, p. 84.
[2] *Nature*, 120, 961 (31 Dec. 1927).

a forerunner of Neanderthal man—is awaited with the greatest interest. Similarly, very marked characteristics are associated with the Piltdown skull, with its great, although still unsatisfactorily determined, age. In particular, the association of a markedly anthropoid canine with a very human face and jawbone impresses on us the fact that the evolution of man did not necessarily proceed *pari passu* in respect of every character, but that while brain and face advanced, the type of his dentition, so to speak, dragged behind.

From now onwards the evidence, gathered within the short space of seventy-two years,[1] is so impressive, both as to scale and detail, that Neanderthal man, who is a characteristic type with the well-marked supra-orbital ridges and massive jaw of a true simian, is more and more considered as a distinct species that reached its climax in the Mousterian, and passed away suddenly like aboriginal races to-day, and whose origin therefore must be sought far back in the Early Pleistocene or, it may be, the Pliocene. Neanderthal man may be held to be a distinct species, because he apparently did not cross with

[1] The first complete Neanderthal skeleton was found in 1856. The Gibraltar skull was discovered in 1848, but its importance was not realized till long after.

any other form, and so became extinct. His characteristics at any rate are not seen in any modern type. The Neanderthal type is distinct from all living races. Every bone almost has some peculiarity, and many of them show a resemblance to conditions seen in the corresponding bones of anthropoid apes. It was this race of Man that occupied Europe and Palestine in Mid-Palaeolithic days, and seems to have spread deeply into the continent of Africa. Neanderthal man is probably equally related to all races of *H. sapiens*. But there are many signs of specialization in the skull and teeth, as well as in the limb bones, that make it most improbable that he stood in the direct line of descent.[1] In Neanderthal man, accordingly, we have no direct ancestor—if Keith is right, men of the modern type were already in existence—but rather a collateral form. Of the skeleton of this short, slouching, shambling fellow there are some forty examples, rarely complete. Yet we know that he could fashion a pretty flint, and there was a sense of the Eternal about him, for he laid his dead to rest equipped for a long journey. The

[1] *Pace* Aleš Hrdlička, who, in his Huxley Memorial Lecture (1927), maintains the position, which he holds will be justified by further discovery and research, that Neanderthal man and his culture were regular and inherent phases of human evolution.

long night of the Mousterian cave life, through the cold of the climax of the Great Ice Age, drove him in upon himself, and he seems to have put, and answered for himself, in a vague manner, some of those questions that have haunted man from the beginning just because he is Man. We are apt to think of Neanderthal man as rather stupid. On the contrary, he must have been singularly acute. It was a clever and difficult thing to live in those days at all. Life was not a bureaucratically conducted trip from the cradle to the grave, as some of our Socialist friends would seek to make it, leaving practically nothing for the individual to do for himself. His thoughts had continually to be on the matter of getting food and warmth, and circumventing circumstances and hostile animals. Man had really to be alive in those days, and exert himself to live at all. His was a genuine struggle for existence, and he had individually to *use his brains*. There were no Trades Union agents or newspapers whom he paid to do his thinking for him. It looks, then, as if, from a very early period, Man had been represented by more than one physical type, even as he is represented by many to-day—with this difference, that the types of fossil remains, discovered so far, indicate profounder variations from one another than do the modern races of

Mankind. And all this only strengthens the case for Man's great antiquity.

The lines of the physical ascent of Man have been made out in broad outline, and by the time we have reached Aurignacian man at the base of the Upper Palaeolithic, we are in presence of a form, especially in the Cro-magnon, that is distinctively *Homo sapiens*, a man like types among ourselves, somewhere on the true line of ascent to modernity. The remarkable feature now is that when we pass thereafter through the phases of Solutrean and Magdalenian man, and then through various stages to what is distinctively Neolithic, and so by way of the Bronze and Iron Ages to the present era, the physical changes are not so marked as the mental and spiritual development that registers itself in cave-wall drawing and implement of flint or bone, in megalithic monument and pottery. Not that the physical evolution has come to an end: on the contrary, it continues to this hour, and will continue. But the great advances over that period from the Aurignacian onwards are in the things of the mind, accompanied, as they doubtless have been all along, by development in the finer structure of the brain. If it can be said[1] with sound critical judgement that for

[1] e.g. by the Abbé Breuil, *L'Anthropologie*, vol. 13, p. 159

spirited depiction of action nothing like some of the products of Magdalenian parietal art was again seen in Europe till the eighteenth century, or that the Classic Age of Attic thought and aesthetic practice has never been surpassed, we can only regain a sound perspective and correct evaluation by realizing how short is the period dividing us from even the more remote of these two historic outbursts of genius, compared with that which separates us from the birth of Mankind. Indeed, compared with the antiquity of Man, how comparatively recent a thing is civilization!

On the other hand, our knowledge about the actual development of human nature accompanying this physical and mental advance is still vague. It is, however, inconceivable that there should have been no corresponding progressive change in this respect, also, over the whole, so that while in every other regard man is subject to change, his spiritual nature and capacities should be the only fixed and static element about him. And the closer the relationship between body and mind is believed to be, the greater becomes the difficulty even for the materialist in admitting such immutability of character. Yet this is a common

(1902); cf. also G. Baldwin Brown, *The Art of the Cave Dweller*, chap. x.

enough belief. The unchangeableness of human nature is urged again and again in derogation, for example, of such a practical ideal as the League of Nations. 'Man will always want to go to war at intervals,' it is said; 'he cannot help fighting.' Thus it has been maintained that at successive periods, a century apart, Europe has been plunged into the turmoil of a war, in every case rounded off by some Treaty of Peace[1]—as if that distracted continent almost required a hundred years for recuperation, before she was constrained to enter upon another war. Even so unquestioned an idealist as Viscount Cecil of Chelwood permitted himself to say in a recent lecture that 'in purely barbarous tribes combat is endemic. The savage walks through the forest with his club or tomahawk as ready to slaughter his fellow-men as he is to kill any other animals'.[2] Fortunately, as we shall see, such general statements are altogether too sweeping. For Man is *par excellence* the educable animal, and to maintain with regard to him, as did the dyspeptic writer

[1] e.g. (*a*) The Peace of Utrecht (1713), which closed the War of the Spanish Succession; (*b*) the Congress of Vienna (1815), which rounded off the Napoleonic Wars; (*c*) the Treaty of Versailles (1919), which wound up matters after the Great War.

[2] First Rickman Godlee Lecture, on 'The Co-operation of Nations', p. 6.

of the Book of Ecclesiastes, that 'what has been is what shall be, what has gone on is what shall go on, and there is nothing new under the sun',[1] is simple treachery to civilization, and a statement in ignorance of the facts. Mr. Coolidge was much nearer the mark in registering his belief, on 11 November 1928, that peace 'is coming to be more and more realized as the natural state of Mankind'. This might be taken to imply that up to the present there had been no such general realization of peace as the natural state of Mankind. If this be the intention, which may be doubted, we have to reckon with the dream of a Golden Age, which has never been far from the mind of Man. In some respects we may have to modify ordinarily received opinion. For while the contrast has often been made with a certain measure of truth, that whereas paganism placed the Golden Age in the past, for Christianity it lies in the future, yet it is not enough to leave the matter at that. It may be that the earliest accounts of a Golden Age represent a vague tradition of actual fact. It may be that, subject to definition, a Golden Age is a recurrent phenomenon. Were the earliest accounts wholly mythical, or did they have any basis in actuality?

The best-known traditions of the Golden Age

[1] Eccles. 1, v. 9 (Moffatt's trans.).

are preserved for us in Hesiod's *Works and Days* (*circa* 850 B.C.) and the first book of Ovid's *Metamorphoses* (A.D. 7). The older record is the scantier, but the cameo is clear cut. Before the creation of Pandora, the mischief-maker, 'the tribes of men lived on earth remote and free from ills and hard toil and heavy sicknesses'.[1] With each successive generation or race, there was a gradual decline from the initial 'golden race' who 'lived like gods without sorrow of heart', making 'merry with feasting beyond the reach of all evils'. It was a generation representing something ideal in humanity—'they are called pure spirits dwelling on the earth, and are kindly, delivering from harm, and guardians of mortal men; for they roam everywhere over the earth, clothed in mist and keep watch on judgements and cruel deeds, givers of wealth; for this royal right also they received.' Already with the second generation—'of silver and less noble by far'—wanton foolishness had crept in—'they could not keep from sinning and from wronging one another, nor would they serve the immortals nor sacrifice on the holy altars of the blessed ones', with the result that 'Zeus the son of Cronos was angry and put them away'. They were followed

[1] Trans. by H. G. Evelyn-White, *Hesiod* (Loeb Class. Library).

in turn by a third generation, 'a brazen race, sprung from ash-trees', who loved 'deeds of violence', being 'hard of heart like adamant, fearful men'. There is associated with them a clear tradition of a Bronze Age. 'Their armour was of bronze, and their houses of bronze, and of bronze were their implements: there was no black iron. These were destroyed by their own hands.' The fourth generation was 'nobler and more righteous, a god-like race of hero-men who are called demi-gods, the race before our own, throughout the boundless earth.' Of such were Cadmus and Oedipus. Some of them 'grim war and dread battle destroyed', but to others it was given to 'live untouched by sorrow in the islands of the blessed'. Of his own generation, the fifth, the poet expresses the wish that he had 'either died before or been born afterwards. For now truly is a race of iron, and men never rest from labour and sorrow by day, and from perishing by night; and the gods shall lay sore trouble upon them. But, notwithstanding, even these shall have some good mingled with their evils'.

The statements in the *Metamorphoses*, nearly nine centuries later, are naturally somewhat fuller. Human history falls into four clean-cut stages—the Golden, Silver, Bronze, and Iron Ages. The first is characterized by a total absence

of social structure. 'Golden was that first age, which, with no one to compel, without a law, of its own will, kept faith and did the right. There was no fear of punishment, no threatening words were to be read on brazen tablets; no suppliant throng gazed fearfully upon its judge's face, but without judges lived secure. . . . Men knew no shores except their own.' The earth literally brought forth of herself, 'without compulsion, untouched by hoe or plowshare. . . . There was no need at all of armed men, for nations, secure from war's alarms, passed the years in gentle ease.' [1] Later 'the silver race came in', and the 'everlasting spring' of the golden era gave way to the seasons. 'In that age men first sought the shelter of houses.' Next came 'the brazen race, of sterner disposition, and more ready to fly to arms, savage, but not yet impious.' Last came the age of 'hard iron'. 'Straightway all evil burst forth into this age of baser vein: modesty and truth and faith fled the earth, and in their place came tricks and plots and snares, violence and cursed love of gain.' Men sailed for other lands, while 'the ground, which had hitherto been a common possession like the sunlight and the air, the careful surveyor now marked out with long-drawn

[1] Trans. F. J. Miller, Ovid, *Metamorphoses* (Loeb Class Library).

boundary-line'. . . . The development of mining brought to light 'wealth that pricks men on to crime. And now baneful iron had appeared, and gold more baneful still; war came, which fights with both. . . . Men lived on plunder. . . . Piety lay vanquished.' In fact man became so froward that Jove decided to destroy him by a flood. The details here are strongly reminiscent of the older Genesis cycle.

These records, then, bear testimony to a belief in primitive conditions of human life, when as yet there was no structure of society, and when, ungoverned and at peace, Mankind lived in contentment and happiness. Thence there is a passage to a civilized state of affairs marked by the introduction of agriculture, followed by the development of metal work. Gold and Silver Ages—symbolic terms, and really corresponding to something if not in Palaeolithic, at any rate in Neolithic, days—are succeeded by Ages of Bronze and Iron. Set into these latest stages are various mythological elements—the stories of an Earthly Paradise, of a Flood and the destruction of the human race, of demi-gods who are attracted by the beauty of the daughters of men and intermarry—elements which are widespread in the dawn of inquiring and reflective thought on human history.

How far back the traditions go is a matter on which it will never be easy to come to a definite decision. We have some reason for believing that the Neolithic Age was distinctively an Age of Peace, of constructive and creative work in all the arts in some regions, in others (e.g. Central Europe), characterized rather by a somewhat stagnant, peasant, contented attitude, with restless Palaeolithic hunter remnants on the outskirts of the communities. There are no indications at any point of large-scale conflict. The evidence certainly suggests that with the development of crafts and metals, with growth of wealth and the accumulation of property as the result of the abandonment of a nomadic life, and with the development and expansion of races, and the building of towns, there was a certain declension from the primitive peaceful relationships and customs, and that the increasing complexity of the structure of social life made the running of the machine less and less smooth. Whether attempts to show that nothing in the nature of weapons of war was known throughout the Palaeolithic Era can ever be successful, is more than doubtful. The Spanish rock gallery of Morella la Vella, Castellon, contains, amongst other representations, one suggestive of a fight in which seven archers are engaged.

It appears, however, to stand alone as a war piece amongst many representations of archers from Alpera, Saltadora and elsewhere in Spain, and there is the further uncertainty as to the exact chronological setting of the Capsian culture to which these representations belong. It is the tradition from the peaceful Neolithic days that is almost certainly reflected in Hesiod's *Works and Days*.

It is a fact, perhaps not wholly without significance in this connexion, that in certain out-of-the-way regions of the earth there have survived until recently, or even to the present time, various races that are characterized by some of the features associated with the Hesiodic primitives—they know no agriculture, and do not work in metals. Interesting accounts are given of their mentality, disposition, and culture, or rather lack of it, by competent anthropologists. In them we see human nature in its most natural expression. Of these I shall refer in brief detail to two. Dr. Charles Hose in his study of *Natural Man, A Record from Borneo* (1926), deals amongst other tribes with the Punans, one of the more aboriginal, and possibly the oldest tribe in that island. They are a nomadic, hunting race, living in small groups in the depth of Bornean forests, and 'so primitive that they are not even agri-

cultural'.[1] 'They possess no houses; they own no more property than they can carry on their backs.'[2] Of fine physical build, they are yet shy, timid, reserved, and inoffensive. Subsisting exclusively on animal and vegetable products of the jungle, they live a real community life. 'What food is obtained is shared by all the members of the group. A hunter, on returning to camp with a piece of game, throws it down before his fellows and invites them to treat it as common property.'[3] Commodities gained by barter or gift are likewise shared in common. 'A Punan will never wantonly slay or attack a man of another tribe, and he never goes on the warpath except when he is accidentally roped in with some other tribe.'[4] Monogamy is the rule amongst them, and marriage is for life. Burial and funeral rites are unknown, yet in song they often express their deepest feelings.

'To hear, in the dense blackness of the jungle, when a few torches alone light up the solemn circle, a Punan recite with dramatic gestures the story of a departing soul, gives an impression which is not without its solemnity or beauty.... Such are those strange people—isolated, not even self-supporting; unresourceful, yet able to make a livelihood at others' expense; simple, yet wise; untrained, and with a fear of the unfamiliar, yet

[1] Charles Hose, *op. cit.*, p. 35.
[2] *Op. cit.*, p. 38.
[3] *Op. cit.*, p. 39.
[4] *Op. cit.*, p. 41.

knowing instinctively what is right; a type of civilization, and a civilization of no mean kind.' [1]

Another impressive instance of this typical, and in some respects ideal, community is provided by the Kiwai Papuans of British New Guinea, amongst whom 'there exists no difference of rank whatever'.[2] Every man is on a footing of equality with his neighbour, and no one has any authority over his fellows. 'No want one man he go ahead, one man he come behind; better all man he go together.' [3] It is a definitely and consciously maintained state of social equality—their village communities constitute societies that know neither rich nor poor, because no one has sufficient property upon which to base such a distinction. The most valuable possessions—houses and canoes—are ordinarily shared by groups, and the possession of other belongings in great number, e.g. implements and household utensils, gives no particular advantage to the owner where it occurs. Every one has all the land he needs, and there is no social differentiation on this basis.

'Every man does the same work and no one employs servants; there is hardly any need to do so, since the

[1] *Op. cit.*, p. 44.

[2] Gunnar Landtman: *The Kiwai Papuans of British New Guinea: a Nature-Born Instance of Rousseau's Ideal Community*, p. 167.

[3] *Op. cit.*, p. 167.

assistance of a man's wife, or wives, and children is sufficient for carrying on the garden work without any great exertion on his part. Related persons, besides, are continually helping each other. Custom also requires any one to come and assist a fellow-villager for a day or two if he is engaged in some particularly arduous work, for instance, fencing-in a larger garden. An invitation to this effect is always accepted, although no payment is given; the participants are, however, entertained with food and sometimes with tobacco, and every one knows that he and the whole village will profit in the future from the common work.' [1]

As a rule a man is not directly paid for any thing he may make for some one else, the sole exception being when a native has recourse to a sorcerer. Such differences as exist are the differences of personality and native ability, but these give no social precedence although they are recognized. In different ways, the great warrior, the man with several wives, the irrepressible orator—'he got plenty talk inside'—enjoy a greater reputation than their fellows, being a 'little more high'.

In the absence of any institution of chieftainship, public affairs are conducted by a group forming a sort of naturally selected 'council of the influential men'. There is no official election: they are just recognized as the obvious men for

[1] *Op. cit.*, p. 167.

the work, and a singular unanimity of opinion and harmony in action pervade the council, and are apparently transmissible to the people in assembly. This council also decides any judicial matters that may be brought before it. 'Women may almost be set down as the men's equals',[1] and Professor Landtman refers particularly to the 'expressions of affectionate and even tender relations between husband and wife' which he often noted. 'Although naturally debarred from the proceedings of the ruling council, the women may join in the less formal parleys of the men when these are sitting together debating common affairs. In many cases the women are listened to attentively, and may earn approval even from the leaders.'[2]

Such examples of child-like simplicity of character and social organization could be added to from practically all over the globe.

'The Greenlander', wrote Nansen, 'is of all God's creatures gifted with the best disposition. Good humour, peaceableness, and evenness of temper are the most prominent features in his character. . . . The result is that there is seldom or never any quarrelling among them.'[3]

Or once again:

'The Greenlander is, on the whole, like a sympathetic

[1] *Op. cit.*, p. 171. [2] *Op. cit.*, p. 173.
[3] *Eskimo Life*, pp. 100, 101.

child with respect to the needs of others; *his first social law is to help his neighbour*. . . . "Therefore, all things whatsoever ye would that men should do to you, do ye even so to them"—this commandment, one of the first and most important of Christianity, Nature itself has instilled into the Greenlander, and he always acts up to it, which can scarcely be affirmed of Christian nations. It is unfortunate that, as he advances in civilization, this commandment seems to lose its power over him.' [1]

Of the interior Salish in the North Pacific Coast Area of America it has been said that 'their ethical precepts and teaching set a very high standard of virtue before the advent of the Europeans'.[2] From almost every inhabited region on the earth's surface, testimony is brought by reputable observers to the existence of primitive peoples still living in a state of very simple intellectual, social, and economic activity. The supposed instinctive pugnacity of primitive man proves really difficult to substantiate. Monogamy is the general rule amongst primitive peoples, although communal or group-marriage is far from uncommon.[3] It is a partial result of that

[1] *Op. cit.*, p. 116. Some considerable modification of this view, however, is presented by H. P. Steensby, quoted in A. H. Keane, *Man, Past and Present*, p. 359.

[2] A. H. Keane, *op. cit.*, p. 367. He quotes Hill-Tout as saying, 'We assumed a grave responsibility when we undertook to civilize these races.'

[3] On the other hand 'not only do we have no knowledge

freedom from restriction or convention of any kind, which results in an absolutely natural choice, and therefore more likely in a lasting one. The unspoiled uncivilized primitive often shows a beauty and harmony of individual and social life and disposition that is less rarely attained under the complicated social, political, economic, and ecclesiastical conditions that are termed civilization. We see something of it in the child, whose unorganized, uncontaminated, and undirected life in relation to itself and its immediate kind, is perhaps representative in some respects of the level of Palaeolithic life and thought generally. Infection, however, from the outside by peoples with some of the characteristics of a higher civilization has often, if not always, resulted in degradation, and the process can in many instances be followed in the case of peoples like the Salish, where the inland and coastal sections differ in traits as the result of impact from the outside world. In very broad outline it looks as if there were some recapitulation in the individual life-history of the story of the race. The advance in knowledge is always actually a step out of a state of innocence with regard to that

of any promiscuous people, but there is also no valid evidence that a condition of general promiscuity ever existed in the past.' (W. H. R. Rivers, art. Marriage, *E.R.E.*, viii. 432.)

particular branch of knowledge. Indeed are there not aspects of the terms 'innocence' and 'ignorance' which so closely overlap as to make them practically synonymous?

All this, however, hardly seems to be sufficient basis for the attempt made by Professor G. Elliot Smith and his school to re-establish the views of Locke and Lord Shaftesbury as to the innate goodness of man, and the significant part played by the introduction of agriculture in bringing the Golden Age of peace and contentment to an end through the resulting creation of property in land and, with that, moral and social inequality. His general thesis is to the effect that 'man is essentially peaceful and good-natured when free from artificial incentives to strife', and that 'the absence of slavery, class distinctions, social organization, warfare, burial customs and religion, and the lack of personal property, were the chief factors that eliminated trouble and made for peace and happiness'.[1] It is a little difficult to believe that the distinguished anthropologist in question is serious in all this, for we know of no period or people where there has been a total lack of some religious observance or faith, nor even of a certain measure of social organization, be it but the

[1] *Human Nature*, p. 15.

family. To argue from that which is non-existent is most precarious. It is certainly the case that religion has caused much trouble, but it is inadmissible to argue that no religion would have meant no trouble.

And here, to make a digression, it is worth while noting how serious has been the damage done both to a sound apprehension of human actualities and to the unique and revealing worth of Scripture in its marvellously interesting testimony to an early stage of ignorance or innocence in the ascent of man, by the unjustifiable imposition of theological dogma upon its simple record. Thus, as far as it has been supposed that the narrative in Genesis 3 tells of an original state of human bliss and moral perfection (to the accompaniment, in the Miltonic rendering, of a high and noble level of intellectual discourse) from which man 'fell' by some single act of disobedience with momentous racial consequences, we are dealing with just such misapprehension. The record, approached without presuppositions, tells of beings who are not by nature immortal. It speaks of consequences of an act of transgression passing over to posterity, but gives no indication whatever of a sinful tendency having been transmitted.[1] Indeed the author

[1] Cf. J. Skinner, *Intern. Crit. Com.*, *Genesis*, p. 97.

of one of the two distinct strands intertwined in the record 'knows nothing of the Fall', a fact that 'reminds us how little *dogmatic* importance was attached to the story of the Fall in Old Testament times'.[1] The wonder and experiential truth of the story have too often been missed in the pursuit of associated baseless figments of the imagination. Later, St. Paul, in his wonderful contrast between the Fall of Adam and the Redemptive work of Christ,[2] maintains that the human race has been involved in Adam's first sin. Well, we know about the need for redemption and the attainment of it in a way in which we can never know about Adam's first sin, and after all, that was St. Paul's real interest. And we begin to know about the place and function of death in the history of life, and the past history of the human race in a way in which St. Paul could never have known, and from the accounts of the conditions of interment of the Chapelle-aux-Saintes and other Mousterian skeletons, we infer a belief in immortality and a consciousness of God at a time many millennia previous to that at which the Genesis stories were forming in men's minds, in reflection upon the world in which they found themselves. Yet

[1] J. Skinner, *op. cit.*, p. 129.
[2] Rom. 5, vv. 12–14; cf. also 16, v. 20

this does not detract from the profound truth of St. Paul's central insistence in this regard, viz. that all that death has come to create of terror and exasperation and resentment in the minds of men, is due to sin.

And so, once again, when on the top of misunderstanding of the teaching in Genesis 3 is still further imposed a dogma of original sin (presupposing a state of original righteousness) as was done by St. Augustine, the mischief is complete. And the curious feature is that the truly great St. Augustine based his dogma of original sin mainly on what was simply a mistranslation of a passage in St. Paul. The reference is again to Rom. 5, v. 12, ἐφ' ᾧ πάντες ἥμαρτον, 'because all sinned'. The Latin, 'in quo omnes peccaverunt'—itself correct—was misunderstood by St. Augustine as referring back to Adam 'in whom' all sinned.[1] The difficulty throughout the ages has been that men

[1] He discusses the passage in 'Contra duas epistolas Pelagianorum', Bk. IV, Chap. xlvii (W. Bright's *Antipelagian Treatises of St. Augustine*). Prof. J. F. Bethune-Baker, to whom I am indebted for direction at this point, gives a summary of St. Augustine's teaching and ideas in his *Introduction to the Early History of Christian Doctrine*, pp. 308–12. Prof. Bethune-Baker states that St. Augustine does not of course depend only on this particular passage, but considers it certain that the misunderstanding influenced St. Augustine very strongly.

come to Scripture with preconceptions and prejudices that often, groundlessly, carry them away off on side issues, and obscure their minds to the profound simplicity of the revelation. As one open-minded commentator has said in a similar connexion:

'Nothing has been more pernicious in theology than the determination to define sin in such a way that in all its damning import the definition should be applicable to "infants"; it is to this we owe the moral atrocities that have disfigured most creeds, and in great part the idea of baptismal regeneration, which is an irrational unethical miracle, invented by men to get over a puzzle of their own making.' [1]

The dogma of original sin and the associated teaching formed no part of earliest Christian truth. Jesus Christ never made any reference to such a doctrine, or suggested it. What He did say was something much more personal and overwhelming—'Except ye turn, and become as little children, ye shall in no wise enter into the kingdom of heaven.' [2] Yet the dogma gripped the imagination of the later Church because it seemed to offer an explanation of certain facts which are more reasonably explained along other lines to-day. The realization of man's animal origin, of his long struggle upwards, of elemental

[1] Principal James Denney, *Expos. Gk. Test.* on Rom. 9, v. 12.

[2] Matt. 18, v. 3, R.V.

instincts and impulses tending towards degradation solely in his misuse of them, of choice between alternatives of action recognized as higher and lower, of the possibilities in the remaking of his nature, together constitute a point of view based on facts that compel some considerable readjustment in theological thinking, if it is to retain its hold on intelligent men and women. Thought to-day concerning the 'Fall'[1] has no reference to a present sense of imperfection in relation to what man once was, but to what he might be here and now, and according to the degree of vividness of that sense is his conscience at work, urging him in the direction of the attainment of his true destiny. The important fact for us is that the world process operates or is operated so as, over the long run, to eventuate in higher orders of life and nobler ways of living. It is a world in which man was evidently intended to work,[2] and to use all his faculties, the inevitable consequence of which, in balanced, serious, and purposeful activity, is progress. Accordingly it is idle to point to contemporary primitive eddies in the progressive

[1] As the word is, in any case, quite unscriptural in this connexion, either as substantive or verb, it would be an aid to sound thinking if it could now be dropped altogether.

[2] 'The Lord God took the man, and put him into the garden of Eden to dress it and to keep it' (Gen. 2, v. 15).

stream of human life, as if they retained that which was wholly exemplary for this present phase of things. In a world that is, throughout, process—which means that its truth is revealed in *proceeding*—persistence in a phase of innocence or ignorance is contrary to the nature of things, and every deliberate attempt to keep a people in ignorance has in the end issued in the direst consequences, as the history of Russia in this century has demonstrated to the world. At the same time the misuse or misapplication of new knowledge gained is always just as possible as its sound use, since man is a creature with a certain measure of freedom. Morality, then, consists in the active and considered regulation of man's gradually acquired knowledge and of his inherited instincts, and the direction of these towards the establishment of what come to be realized as the higher ends both of the individual and of the race.[1]

From this developmental point of view, primitive humanity lost as it gained: it is a question of proportion, of perspective. A state of peaceful equilibrium may be advantageous, but it is not productive of advance or progress. A state of static ignorance or innocence is not necessarily goodness. Certainly in the earlier

[1] Cf. Prof. J. F. Bethune-Baker, *The Way of Modernism*, p. 65.

nomadic stages of human history there can have been no great tendency to acquisitiveness. Life was taken up with the struggle to survive. It was with agriculture, which meant a certain fixity in regard to the soil in a special locality, that acquisitiveness really began. There was something now to collect—grain, or stock, or metal (for this followed hard on the agricultural stage, if it was not absolutely contemporaneous). 'In some way, therefore', we are told, 'the use of metals, the knowledge of agriculture and the cohesive culture they postulated are linked with certain predatory and inharmonious forces with which they have no natural association.'[1] That of course is perfectly true, but it does not 'inevitably point to the narrowing of the first experiment in civilization to a single area',[2] as some exponents of the school of thought in Great Britain to which reference has already been made, to-day maintain. What it does suggest is that as soon as there is any crystallization or fixity—anything of the static—in the conditions of life, degeneration follows in some vital respects, unless the community is peculiarly alive to the dangers. Acquirement immediately provides a basis for the development of the same tendency

[1] H. J. Massingham, *The Golden Age*, p. 30.
[2] *Op. cit.*, p. 30.

in others and consequent possible jealousy. A child whose parents' profession involves it in being continuously moved about from place to place does not usually develop this sense of property to the same degree as a child that lives its life in a fixed nursery, and has its own box or cubbyhole where it daily lays aside and stores its own possessions. Yet the sense of ownership in property is so strong in children as a rule as to suggest that it is very old.

Not merely therefore does there seem to be some weakness in the main thesis of the Diffusionist School, but the well-known position to which it leads, viz. that all ancient civilization originally came out of Egypt, is already apparently sapped by Sumerian facts, and envisages a movement which in any case seems to start altogether too late. If, according to one of Professor S. Langdon's latest summaries, 'a date before 4000 B.C., must be assumed for the founding of the first proto-Sumerian cities in Mesopotamia',[1] and this proto-Sumerian people, now definitely identified as Elamite, can be linked through their script with other elements in a 'prehistoric civilization which spread over Asia from China to the Mediterranean before 4000 B.C.',[2] then it is apparent that the race movements and migrations in Asia previous to

[1] *The Times*, 4 Jan. 1929. [2] *The Times*, 28 Jan. 1928.

that date must have been on a very great scale, with which perhaps, in the light of subsequent discovery it will be found that even the Badarian culture, preceding the Early Pre-dynastic in Egypt, is not altogether unconnected. Diffusion there certainly was in many cases, but it is impossible to believe that the idea, let us say, of crossing a stream on a log, or of the bull-roarer, occurred originally only to one mind or group of minds in one locality, and thence spread throughout the world. It is contrary to so much experience and fact. Given such an organ as the human brain, it is most improbable that it should not, sometimes, under similar conditions, react in the same way. Indeed the fear of priority in discovery being established by some other worker, is one of the few terrors for the modern man of science.

With the dawn of culture, the development of social ranks and classes, and political institutions such as the kingship, there was brought into existence a new arena for rivalry in acquisition. Property in land following on agriculture was a great element in the development of that moral and social inequality that has resulted in so much human misery. It is, however, a curious supposition to imagine that 'agriculture was the invention of one man who virtually established two of

the greatest forces that have ruled both the concepts and the conduct of mankind—theology and the kingship, and it is only within quite recent times that these two elements have become disjoined'.[1] It is much more probable that agriculture was the chance discovery of women in various places, who remained around the settlements of primitive Man, and noticed that parts of fruits and grain that were left lying about near their homes sprang up under certain conditions, and reproduced themselves. The advance to leadership of some individual who showed special ability in connexion with agriculture or hunting, or relations with other neighbouring clans, gradually led on to the emergence of the kingship, and he, after his death, and sometimes in life, was invested with, or believed to be a wielder, of supernatural powers. Belief in the power of water as a fertilizing agent, natural to those who lived in the deltas of the Nile or Euphrates, was extended to other substances like gold, shells, pearls, and precious stones, and the quest for these possibly led to the first voyages of exploration. It was not a great advance to suppose some of these substances to have even the power of conferring immortality, and the early association of life

[1] H. J. Massingham, *The Golden Age*, p. 35.

with blood brought the latter very directly into the whole association of ideas on the subject of immortality. Indeed the desire for blood as a renovator or rejuvenator, through the capture of victims, may well have been on occasions a motive for primitive raids.

The idea of a Golden Age will ever remain in the minds of men. And now that it has been most abundantly proved that it cannot be brought about by any change in material surroundings alone, although there are certain modern conditions that it is increasingly realized can have no place in such a Golden Age, we believe that there will be a return to the investigation of human nature, and the best conditions for its development. When we speak of human nature, we really in the end mean capacity and behaviour—a set of ways of reacting to situations which is assumed to be fairly constant amongst Mankind. To what extent can these be modified, and how? It is too often merely assumed that human nature is a constant, and the assumption appears to be mainly based on a few centuries of characteristic behaviour of European peoples. The question may, however, well be raised whether it is, as a matter of fact, true that supposedly distinctive tendencies or characteristics, such as cupidity or bellicosity, have been

everywhere and at all times exhibited by Mankind. Thus, the slightest acquaintance in broad outline with Chinese history reveals even at a comparatively early stage century-long periods of peaceful prosperity in Central China such as were never experienced in Europe. It might even be said that the persistent pacificism of the Chinese has been the really dangerous thing about them. The soldier was looked on as the lowest type in the social organism. Every one was 'too proud to fight'. The recent ebullitions have seemed so fatuous just because they were so un-Chinese. Man is in the making, even if, in many instances, it seems as if he were in the unmaking. The idea of the fixity of human nature has as little basis in fact as had the old idea of the fixity of species, or of the elements.

Accordingly we maintain that human nature not merely can be changed, but is being changed —that is to say, it can be, and is being, developed along lines that result in greater fullness and more abundance of life, not merely physical and material, but moral and spiritual. Increasingly man will be able to remove the disharmonies in his life, individual and social, and control more and more his functioning and destiny. Already we know, for example, how certain types of human abnormality and subnormality can be

rectified by the administration of such substances as thyroxine. Probably many of the great advances in the future promotion of general welfare will be even more along the line of injection and application of bio-chemical substances against the ills that harass and decimate and hinder the progress of humanity, than along that of the improvement of the race, for example, by the breeding of immune strains. Can human nature, then, be changed as a whole, normally? And the answer must again be that this is what is actually in process. Instincts are being gradually sublimated. We stand on the threshold of an Age of Reason in which Reason is, and will, increasingly come to control man's attitude to, and direction of, life.

Probably along this line lies the answer to the deep, sometimes pessimistic, concern displayed by several recent writers with regard to the future evolution of Mankind, and their despairing call to safeguard and conserve the purity of certain specified races.[1] So far as miscegenation is concerned, the expectation of preventing this is hopeless. Such purity of race as exists is always very comparative. There is no organism so

[1] e.g., H. G. F. Spurrell, *Modern Man and His Forerunners*, chap. viii; E. G. Conklin, *The Direction of Human Evolution*, chap. v; W. R. Inge, *Outspoken Essays* (Second Series), p. 209 ff.; H. F. Osborn, *Man Rises to Parnassus*, pp. 184–7.

mongrel as Man, and the supposedly highest races of to-day—from whatever point of view so regarded—have issued at one point or another from some antecedent welter. But the white man can apply his rapidly extending medical knowledge to the encouragement and preservation of what is empirically proven to be the best physical and spiritual types of humanity, irrespective of colour, and this will increasingly be an individual rather than a racial care. If it is the case that the psalmist's estimate of human life[1] is still absolutely unaffected, as a general statement, by anything that has been achieved by modern science, yet science has brought about the possibility of very much larger numbers of individuals reaching that limit, than was the case in previous decades or centuries. Within the last century in particular, very much was done to reduce the death-rate and incidence of diseases in youth. The expectation of life for all infants born to-day is very much greater than ever it was. So also a greater proportion of individuals who have reached middle life may have the expectation of reaching the psalmist's limit, but there is no expectation of absolute increase for Mankind as a whole as yet. It is important to keep the distinction clear between an increase in the

[1] Psalm 90, v. 10.

maximum span of life and the average expectation of life: there is abundant evidence for the latter, but none at present for the former. The situation in regard to infancy has improved at a very remarkable rate within the last twenty years. The Secretary of the Public Health Department of Glasgow 'has recently shown that in 1870–2, the male infant born in that city had an "expectation" of thirty-one years, which in 1920–2 had been raised to forty-eight years, and the female infant had risen from thirty-three to fifty-two in the same period'.[1] Cancer is more common to-day, it may be stated in reply, but this may be held to be due in part to the fact that the infantile death-rate is falling. That is to say, an increasing number of people are reaching middle-age, which is the cancer age, and so more cases of it are apparent, because there are more subjects in whom it can appear under its specific, and as yet unknown, conditions. Cancer is certainly a more frequent cause of death to-day, but people who would have died of it in previous ages, died earlier from some other cause. I am assured on excellent authority[2] that within the

[1] Presidential Address, Royal Sanitary Institute, by Sir George Newman, *Journal of Royal Sanitary Institute*, vol. xlvi, No. 3 (1925).

[2] Dr. J. D. Comrie, Lecturer on the History of Medicine, Edinburgh University.

last 2,000 years, of which 800 are known with fair accuracy, the gamut of disease has probably been traversed, and if there is some notification of a 'new disease' anywhere to-day, it is usually found to be the case that some account of it is already on record in the past. It is, in fact, improbable that absolutely new diseases are now coming into existence to take the place of others[1] as the latter are being progressively overcome, although certainly there are modifications in the types of disease, and others come and go in cycles. The present-day increase in nervous diseases is an accentuation brought about by modern social conditions and the stress of life, which will in time undergo readjustment.

But, further, there is a natural capacity in Man, by direct inheritance from previous forms of life, for an Other-regarding life, and it too is historically in process of gradual development. Man can and will move towards a higher type of individual and social life, in which character will be the sole criterion, and all the present-day artificial criteria such as wealth, rank, and so on will gradually lose the present-day estimate too often set upon them. The futility of war will be

[1] There may be some rare exceptions to this statement, e.g. Tularaemia, which was unrecognized as a distinct affection in the U.S.A. until about 1907, although it may have been under examination in Japan some seventy years earlier.

realized, and its childishness outgrown. Man in a peculiar way, can consolidate the fruits of his experience, and as Pascal put it, he is born for infinity. 'The whole human race, throughout the succession of centuries, ought to be considered as one man—ever living and continually learning.'[1] But all this does not mean any embracing of a Socialistic, still less a Communistic, creed as ordinarily understood. This has little in common with the Communism of primitive man, and has only been maintained in its extremer forms, whether in Peru of old or Russia to-day, by tyrannical, and so confessedly unintelligent, measures. Existence in itself implies no right to live, while procreation carries with it serious responsibilities towards offspring, the evasion of which by increasing numbers must be more drastically dealt with by the State. The study of eugenistic theory and practice should be one of the new commandments, even if as yet we have not sufficiently exact or complete knowledge on which to base any positive, as contrasted with a negative, system of eugenic application. The problems of heredity will then

[1] 'Toute la suite des hommes, pendant le cours de tant de siècles, doit être considérée comme un même homme qui subsiste toujours, et qui apprend continuellement.' (*Œuvres de Blaise Pascal*, A La Haye, ii. 9; from a Preface to *Un Traité du Vide*.)

be reduced to insignificant and manageable proportions, and the supreme importance of the environment at last realized. Again and again we must look for social and political upheavals, unless the citizens as a whole are prepared to take a much more direct and active interest in the welfare and general running of the State at home and abroad, and particularly in the provision of the opportunity for all to enter into a fuller and more abundant life. For Man can *make* the environment suitable, both physical and spiritual, *if he will*. The will to do arises in Science as in Religion from a vision of the ideal, and a deep sense of present shortcoming. And once it is realized that religion is the last and highest expression of that *élan vital* that has characterized the history of life from the beginning—that reaching out towards a richer, completer, more harmonious life, which was all unconscious until it became aware of itself in a human mind—Science and Religion will again join hands in the endeavour to help Man towards the achievement of his revealed and true destiny.

LECTURE III

NATURE: DIVINE

THE general conclusion of the two preceding lectures was to leave us with a conception of eternal process, in whose universal, linked stages the inorganic and organic find their place. The doctrine of evolution is statement of fact. But in so far as it is considered and stated to be something more than mere changeableness, it partakes of the nature of interpretation, evaluation, assessment. In the measure in which it is maintained that it evinces progress over the whole, yet also degeneration there and static equilibrium here, the evolutionist has moved over from the realm of fact into the realm of appreciation, and his doctrine becomes significant for Reality. The evolutionary process is in the last resort, on the physical side, to be viewed as a manifestation of the working of Infinite Energy, the source of which admittedly is as yet unknown. Since matter, as we know it to-day, is a materialization of energy, the old-time dualism here may be held to be resolved in favour of energy: it appears, at any rate, to be the more ultimate of the two, and matter but one of its many forms. There is no longer that of which we can speak as 'brute

matter'—nothing at any rate that to the mind of the modern physicist is dull, inert, irrational. It is all rather 'spiritual' in a wide acceptation of the term, in that it is apparently being used for, or moves towards, an end. Modern physics, with its energetic view of matter, has disposed very effectively of the old, and indeed of any, materialism.[1]

The process further admits of clear description in mechanical terms, yet mechanism cannot explain itself, even if we were quite sure what we mean by mechanics. With the most liberal allowances of time, we are yet driven back on some Ultimate, or World-Ground. From the linkage of the inorganic and the organic, and the broadly progressive character of the process, so far as we can gauge it in the case of our own planet, we gain an impression that things are moving in a very definite direction, that there is an urge or nisus, to use the terms of two well-known philosophers, that is getting somewhere. Possibly the most striking feature about the universe is just the fact that wherever we, as it were, make successive cross-sections of it at varying periods, we become aware of trends or

[1] For an admirably stated admission of this point, cf. Bertrand Russell's Introduction to the new edition of Lange's *Materialism*.

tendencies in it as a going concern. This might appear to follow from the mere fact that it is a going concern, but not necessarily. What is remarkable is that if we take sufficiently long series, such as the history of a planet like our earth, or of some distinctive feature of it such as the record of life, we find, on the whole, a definite sustained direction of evolution, so that on the inorganic side, as has been said, 'a grander, more diversified, and more beautiful geography than the present one the earth has never had',[1] while on the organic side successive forms have been characterized by a growing measure of control over themselves and over the environment, with which also they have come into an ever wider and deeper range of commerce. The more closely we examine the stages of the organic process, the more it gives the appearance of a process issuing in increasing fullness and abundance of life—in forms showing greater complexity and integration of structure, increasing independence of the environment, growing self-determination, and enhanced power to modify present behaviour in the light of past experience. This is a very marked characteristic, whose essence is really obscured in such uninforming words as 'trend' or 'tendency'. We seem rather

[1] Cf. p. 3.

to be face to face with some creative activity that is slowly working out a great idea dimly cognoscible by us—slowly because of the refractoriness of the material, particularly when it takes the form of living beings, each with their particular degree of free will. It is really not altogether easy to see how with absolutely unchangeable laws there can be a broadly progressive process and emergence of the distinctively new, unless we either posit some measure of spontaneity at the heart of things, or believe that inasmuch as the process is itself developmental and spiritual, there may be through the aeons some degree of development in the relations that go to constitute it at any widely separated series of moments. Of that spontaneity Heisenberg's 'principle of indeterminacy' may, perhaps, be held as witness—something in the inorganic possibly analogous to that which we speak of, generally, as free will in the higher reaches of the organic.

For many, accordingly, this implies that in some kind of a way we have to associate Mind with the activities of this Infinite Energy. There are, further, the great facts of the intelligibility of the Universe, that the physical basis of things is of a mathematical character, that what we see everywhere are definite quantities and proportions

and relationships, that there is a considerable degree of predictability about things, especially in the inorganic, that the structure of the universe seems more and more to conform to the structure of exact thought. To suggest that this sustained, orderly, pulsating, rhythmical way in which things on the whole progressively advance is all a haphazard affair, makes a greater demand on our credulity than the most crude literal acceptance of an Old Testament miracle.

As to the relation of Mind to this Infinite Energy, we can as yet, however, form no clear idea. Nor is this remarkable, seeing that no man can very satisfactorily explain the exact relation of his mind to the muscles called into action in the apparently simple process of raising his arm to his head: a series of mere physiological sequences, however closely linked, does not constitute an explanation in any ultimate sense. It is characteristic of much present-day physiological research that Professor E. D. Adrian, while affirming that some of the processes which take place in the nervous system can be treated in terms of physics and chemistry—'and there will be no need to alter our methods of approach until we have gone a great deal further by the recognized routes'—at the same time maintains that while the nervous system is 'a material system

somehow responsible for such non-material things as emotions and thoughts', yet the latter 'are in a category outside the range of mechanical explanation, and for this reason the working of the nervous system will never be fully explainable in terms of physics and chemistry'.[1] The suspicion that there is an 'organic category', more fundamental and inclusive than anything subsumed under the inorganic, slowly gains ground. It is at any rate impossible to derive mind from matter, or even from energy. If this last dualism is to be resolved, the probabilities are that the resolution will be in the direction of the priority of creative mind, for while mind can at any rate form a picture and theory of the character, say, of an electron, and the behaviour of such energy, there is not the slightest evidence that the compliment can be returned, so to speak. The association of mind with the energy at work in the world-process is forced on us, as we have said, in contemplation of the sustained and broadly progressive character of the process as a whole, with its present climactic *dénouement* in man, who is no interloper. So that the Whole, in the

[1] 'The Mechanism of the Nerves', *Nature*, 123, 167–9, 1929. So also Prof. Boycott: 'So far as I can see, the attempt to "explain life by chemistry and physics" has completely failed.' (The Transition from Live to Dead; the Nature of Filtrable Viruses, *Nature*, 123, No. 3,090 Supp., 1929.)

measure in which we can relate the story of our planet to it, may be said to partake in some measure of the characteristics that distinguish man at his highest. Yet this frank anthopomorphism—this recognition of something of himself in the process—while not a final word, must in some degree represent a part or aspect of the truth concerning the Whole, just because man is a genetic product of the process, and may mirror in his mind its essential nature. He himself is purposive in his activities: it is therefore probable that this choice fruitage of the tree of life thus reveals some characteristics of its source.

Another impressive feature of the process is the fact that, over the whole, in its elaboration, it is substantiating those moral values on which man is increasingly coming to set store. It is a particular kind of process, which is apparently gradually working for the realization of the Good, the Beautiful, and the True. We believe that this is as undeniably true of the life of nations, as of the individual life. The achievement can only be secured through man, but man, however he reaches these supreme conceptions, finds that they are viable, and have survival-value, in that progress is associated with them. Yet even here there is no absolute discontinuity between man and the rest of organic creation. In the animal

kingdom, particularly from the level of the birds and lower mammals upwards, it is apparent that Nature has set a premium on such types as have shown capacity for healthy living, for preoccupation with the interests of progeny, for insatiable inquiry into, and examination of, their immediate environment, so that advantage was taken by them of the possibilities missed by others. In their own way they followed the Good, the Beautiful, and the True, and so brought about that 'more abundant life' that issued in racial progress.

Once again we are compelled to notice that it is a process which is issuing in this particular way, viz. that there are quite definitely and growingly ascertainable conditions of its product of more abundant physical and spiritual life. We are part of a process that is a rational orderly Whole, with these tremendous possibilities in it, emerging at every stage through struggle and suffering and service, and in that way alone. This conception of the wholeness in things is further brought out when we reflect that organisms are always reacting to a stimulating, supporting, we may even say a beckoning, environment, at first and always inorganic and later biotic, which likewise is in process of development, with a character at times and at places of

progressive fitness, to which the organic process directly responds. Natural Selection, a much misunderstood and misused term, is simply a name for the results of that reaction. The world-process is apparently characterized by an expenditure of energy that is controlled and directed with specific results. This movement or endeavouring or striving becomes intensified in those distinctive constellations of matter which we speak of as living, and comes more and more into evidence with advance in the forms of life. Just in the degree in which the organism can separate itself from the rest of the process—in its control of it—does its advance consist. But physically this separation can never be complete: spiritually it may advance to a degree in which man can separate himself in thought from the rest of the process, can determine its character, and can wilfully co-operate with or hinder it, whatever he finds that character to be.

Further, if following Lawrence Henderson's classical demonstration,[1] we find our planetary environment to be as fitted to life as life is to it, we have a Whole, seemingly purposive, with that purposiveness becoming growingly more evident. Teleology, or striving for an end, is

[1] Cf. *The Fitness of the Environment*, 1913, and *The Order of Nature*, 1917.

characteristic of living organisms, and the higher the organism the more manifestly does it come to light in coherence and consistency. But that does not mean that it is excluded from the inorganic, and was not in the preparatory, azoic, phases of the world's history. On the contrary, not merely does the inorganic purposive adaptedness become actually, through the assimilation of its elements, part of the organic, but that world-history as a whole is of such a kind that the more closely and connectedly it is studied, the more it suggests a gradually representative focusing, or concentration of the mental aspects of the process in ever higher types of derivative mind.

On the other hand, process and Cause or Ground, are not the same thing. After the fullest elaboration of the sequential data connected with any phase or aspect of the process, we are still left, as we have seen, with the fact that it is a sequence with an urge that carries it in a specific direction issuing in markedly characteristic results. There is a noteworthy tendency in modern science to rest content with description, ever more refined and exact, of series of sequences, and eliminate the conception of Causality. But such a *tour de force* leaves her accounts more remote from Reality than ever

before. We can outline the process relating man to the rest of the organic phase, thence pass back into the inorganic, and demonstrate the linkage in turn, not merely of our earth's history, but of that of the development of our solar system, with the rest of the celestial economy. Even if, as is most improbable, our planet were the only stage for the production of the *Divina Commedia*, with its inescapably haunting theme in which the more the actors fail, the more they play into the Author's hands, that would but enhance the already terrific cost of the process. Yet such an account is but a play with the *motif* left out—a *tableau vivant* rather than a play.

These are the facts of which we have, then, to attempt some rationale. What is the nature of the urge—this 'Drang nach Oben'—and the ultimate character of things? Is it, in the end, merely some ceaseless mechanical routine with certain variations, positive and negative, or is it more truly thought of as a creative progressive life? Admittedly the problem seems almost intolerable in its immensity. Titanic forces unite sustainedly to produce results that are, over the whole, broadly continuous in their creation of more complex integrated 'wholes', which in their reaction make more of their existence, establish a greater independence of

and control over their environment, organic and inorganic, and thereby give more significance and purpose to that existence. If we use the word 'God' at all, can we mean anything more than these forces as a Whole, the sum of things that has eventuated in this kind of a way? Is there any sense other than a poetic one, in which Nature may be said to be Divine, or may there be a Divine Nature or transcendent Godhead or Godhood actively and immanently related to the process, and apart from which, in the end, it simply is not intelligible?

Or to put the matter in a different way: the ultimate question for Science, Philosophy, and Theology alike is that of the nature of Reality. Each of them attempts a solution in terms of its own categories and the application of its own methods, and each attempt is based on experience of one sort or another—Science on that mediated mainly through the senses and perception generally, Philosophy, in so far as it is held to include Psychology, on its experience of the Self, and Theology on religious experience. In every case the experience is experience of Reality in some one or other of its aspects. The experience is worked up into a philosophy or systematic account, and just because it is never complete, is always pointing to something beyond it. Is there

some one amongst the many interpretations or accounts of the Whole which appeals to heart and mind in a way that is more convincing than the others? Yet let it be understood that whatever interpretation be admitted to this high place, even it can only be symbolic and partial as a representation of Ultimate Reality, though not on that account necessarily untrue. The fundamental concepts of modern science, be it electron or gene, deal with the invisible, while St. Paul spoke of God as One 'whom no man hath seen or can see'.[1]

Attempts at interpretation have been made again and again, but as the facts become better known, the challenge renews itself, and man will maintain the attempt to resolve the secret to the end. There are various competing explanations, and those in terms of Materialism, Naturalism, Mechanism, and so forth—all more or less of the same species, although emphasizing different aspects—have had a long innings. Each has its element of truth, yet none of them to-day is ultimate, for we can see beyond them all, and appreciate their limitations. To the limitations of Materialism and of Mechanism reference has already been made. Naturalism likewise stops short for lack of categories and organons of

[1] 1 Tim. 6, v. 16 : cf. John 1, v. 18, 1 John 4, v. 12.

interpretation just where the situation becomes definitely interesting. In fact no explanation will ever satisfy the human reason that does not in some way make Mind of the essence of the process. We are living in a superficial age, and it is only in such an age that a philosophy like Behaviourism, for example—one of those theories which, as Professor C. D. Broad has said, are 'so preposterously silly that only learned men could have thought of them'[1]—could have made even any momentary appeal. We have to go deeper if any measure of lasting intellectual satisfaction is to be secured.

Religious experience, however we may define it, is a fact in the world, which in its creative and recreative power as expressed in the highest personalities that have walked this earth, has been the most potent factor in human history. It is further a fact in the normal functioning of the human organism, which must be considered fundamentally from the biological point of view, for it may turn out after all to be the form taken by his lively reaction or functioning to that which is felt to be most ultimate in his environment. It may be, as we have seen, the most highly developed expression of that urge which drives him, in common with all other organisms, to

[1] *Mind and its Place in Nature*, p. 623.

come into completer and more harmonious relationship with his environment.

Possibly more has been written upon the subject of religion than upon any other theme in the world. Yet there is nothing more intrinsically remarkable in religion than in the character of the world process as a whole, religion being simply man's reaction to that process and its character, as it impresses itself upon him. It is reaction to the environment, but to an environment which in its subtler, deeper, and more ultimate aspect is, crudely and dimly at first but increasingly, realized to be spiritual, that is to say, moving and working towards high ends. In the measure in which man does not understand he fears. In its beginnings Religion is indeed a reaction in which awe is the dominant characteristic—it must have been so in face of the demonstrations of the titanic forces of Nature to which primitive man was subject, particularly in the later phases of the Ice Age—and even when certain forms of animal life, as in Totemism, were *thought* into closer association with particular tribes than with others, it was largely in a dimly perceived kinship with them, or something inexplicable in them which yet satisfied a need of the tribe, that the mysterious regard had its origin. But when with the progress

of observation on the results of different ways of life or reactions to the process, man realizes that conduct of his has not been along the lines of what he comes by experience to learn to have been best in the interests, it may simply be, of the tribe, these fears are intensified. Out of his reactions, arising often from the quaintest and most illogical of deductions, develop the various forms and ingredients of primitive religion. The point, however, is that they are all reactions to some stimulating cause, not mere projections of man's mind. The projection hypothesis goes too far: it logically leaves nothing—not even the individuality in speech and action of our friends —that is not the projection of our own minds. This emotion of awe can never have been anything of the nature of a 'projection'. Nor is anything really explained by saying that Religion arises from auto-suggestion. All suggestion must come from somewhere, and suggestion that raises the whole level of individual and corporate life cannot be wholly explained from within that life. Water cannot of itself rise higher than its source. Nature was antecedent to man's mind: she brought him forth, and it is to her many-sided beckonings—of some of which he in the end speaks as 'revelation', though this is true in varying degree of them all—that he

responds. Religion is the supreme form of that adaptation which is life. True personality in man, his spiritual nature, like every other element in his make-up, in a direct responsive adaptation, in this case, to that which is Ultimate in his Environment.

Religious experience is and has been open to all men from the beginning, and is the same kind of thing everywhere, although it may differ widely in intensity, in interpretation, and so in effect upon conduct. In some individuals this spiritual or higher sensitivity has been more acute than in others. In particular one nation, the Jewish people, at a certain stage in their history, evinced it in a higher measure and in a greater number of their people than any other, so that they became in an unusual degree exponents of the knowledge of God to the world. The experience of Ultimate Reality varies indeed in depth and clearness, but in every case, so far as it is true experience, it is experience of the same Reality, and has been throughout the ages. In its superlative manifestation—in the Person and Life and Death of Jesus Christ—it took the form of the conviction not merely that God exists, but that He is Love, and has an individual interest in the lives of His children.[1] This declaration

[1] 'In the Old Testament the particular word "Love" is

stands therefore as the supreme religious declaration, and as such calls for investigation and examination as a philosophy of the world process. It is, of course, to the religious mind and to the Christian mind, in particular, something more: but it cannot be less. And it is in this aspect that we venture to consider it. Is it possible to construct a philosophy on such a basis? What is the nature of that Reality in reaction with which in its more spiritual aspects the religious side of man's being is exercised and developed? We have seen its characteristics as revealed in the world process as a whole. We have noted that it is pre-eminently a process in reaction with which man has come to develop a sense of varying worths based on effective observation and experience. It is this correspondence between the ends on which man has come to set chief value—Truth, Beauty, and Goodness—and their actual substantiation and increasing significance in the working out of the process that is the fact calling for explanation. They represent aims whose attainment is sought by man along the lines of intellectual endeavour, emotional susceptibility, and ethical striving. They represent

hardly ever applied to God; and where it does occur in a later writer, it denotes God's special covenant love for Israel' (H. Schultz, *Old Testament Theology*, Eng: Trans:, ii. 160).

the goal of the perfectly functioning man, and at the same time are both coming to light and being established in the working out of the process. And that working out is now a co-operation between man and the process.

Such an investigation is all the more necessary, for the new science is giving a universal background to whatever religious faiths may persist in the world. It is against this common background that they will all have to maintain themselves. It seems clear that that expression of religious thought will alone have the possibility of survival which can show that it is not unrelated to the rest of thought and knowledge. The one that can show most coherence with the best established world view, or, related to some such outlook, can give the most satisfying interpretation for mind and feeling, will alone offer a motive for worthy living. Is there such a scientific-religious outlook? It is the suspicion that there is such a thing, and indeed that there ought to be such a thing, that explains, I think, in part the revival of interest in religion to-day. Men and women are becoming discontented with the sheer emptiness of wholly selfish and animal living, and feeling that there must have been something amiss in the official ecclesiastical presentation of religious and theological truth,

are beginning to try and find things out for themselves. The beauty and self-sacrifice--the active Christianity—of the lives of so many in the ministry is a sort of sheet anchor to others who are sometimes tempted to despair of everything, and it can only find its source in a genuine conviction and experience. But the related Christian thinking has often seemed to be behind the times, and it may be fairly maintained that men like Sir Oliver Lodge, Professor J. Arthur Thomson, and Dr. T. R. Glover have done as much as, if not more than, some of the professional theologians to make religious truth intellectually acceptable to their generation.

Beyond the scant indications already given, we cannot examine the evidences that may be offered for the existence of God. There can be no proofs in the ordinary sense of the word, since *ex hypothesi* if God exists, He is the Ground of all thinking and activity. Further, if He is Love, that mere fact necessarily implies an inward compulsion of creative activity to which in one sense no limit can be set in time or space, yet which in another is limited by the fact that the reciprocity of Love in created beings desired by the Great Lover is valueless, except in so far as it is the spontaneous expression of free moral

beings. And this in turn implies *process* in the carrying out of the divine intention, because such free moral beings cannot be *made*. This process of the gradual development of free moral beings involves self-limitation on the part of God, as also the possible misuse of such incipient freedom as man may have attained. And when it became evident on the basis of the historic facts that man had reached that stage of development beyond which he could not further rise without some clearer vision of the Divine Life—was in short failing to continue to develop in line with the Divine Purpose and Hope—there was a further pulsating expression of that Love in One who has ever since been the Ideal for the generations of the sons of men. That is to say there was an intensification of creative and redemptive revelation in a Perfect Man who impressed His fellows as being the 'express image' (*χαρακτήρ*)[1] of God Himself. Human perfection is divine. Perfect Manhood is the manifestation of Godhood or Godhead in the flesh. It was an even more effective limitation of Himself in time and space, because man, moving towards completer personality, was at a stage to be more impressed by a Personality

[1] Heb. 1, v. 3. Cf. 2 Cor. 4, v. 4, Col. 1, v. 15, where the word used is *εἰκών* (image).

than ever he had been by anything in the providential economy of Nature, and how otherwise than through a Person could such an attribute as Love have been convincingly revealed? In this connexion, Man's only intellectual mistake to-day can be in limiting himself to the categories of the early generations of Christians in thinking of and attempting to estimate a revelation, the significance of which, apart from some half-dozen divinely illuminated minds, he is only beginning to understand.

And so we turn once again to a very old interpretation, prepared, as the result of the insufficiency of other interpretations, to reconsider it afresh. There are difficulties even here, no doubt, possibly in some respect as grave as any with which we should be faced in connexion with the other interpretations from a purely intellectual point of view. Yet when we have let all these characteristics of the process (unity amidst great diversity, order, sustained progress, &c.) produce their full impression on us, we feel that they are all, at bottom, of the nature of Mind—that is to say, manifestations and embodiments of Reason. And this is no mere reading of our minds into things, for if that were so, we should find order throughout, whereas we have the ability to discover disorder as manifested

in intelligences and indeed provide for them, quickly recognizing them by their words and works. There is then evidence of mind in Nature, and there is a philosophy or interpretation of Nature—no matter what its origin—which in its most compelling form was formulated thus: 'In the beginning was the Logos or Divine Reason, and the Logos was with God and the Logos was God. . . . All things were made by him: and without him was not anything made that hath been made. In him was life; and the life was the light of men.'[1] For the moment I am not interested in the later identification or interpretation given by the same writer. I simply wish to maintain that taken by itself I know no more satisfactory philosophy of the universe. For it implies that the creative process is a rational, orderly process,[2] that its time-aspect represents the gradual manifestation of a Supreme Mind or World-Ground, and that man, as owing his being to that Divine Reason, can therefore understand the universe and its meaning. 'The true light', says the same writer, 'which lighteth every man, was coming into the world.'[3] That is to say, he envisages a process

[1] John 11, v. 3, 4.

[2] Indeed for this same writer the words 'world' (*κόσμος*) and 'order' were synonyms.

[3] John 1, v. 9.

in which he regards the Logos as increasingly becoming incarnate through the ages, and so leads up to the climax of the process in the specifically Christian assertion and identification —'the Logos became flesh, and dwelt among us . . . full of grace and truth'.[1] The Infinite Mind-Energy or Ultimate Reality, that is to say, is creative. It is ever moving towards completer self-expression and manifestation, which in time and space take the form of the world process, and came to such clearness in One Personality that men in all ages have related Him to that Infinite Mind-Energy in a very peculiar and distinctive way. We may think of the universe, of man, of this Supreme Personality as, all of them, children of God—to resort to theological terminology. Such a presentation puts no strain on what we have learned from the strictly scientific approach. It is only a change in the terminology. If this presentation is at all supportable, it carries with it the implication that to this Mind, as the Light of men, must be present in eternal perfection these conceptions, based on their absolute actuality in it, of the Good, the Beautiful, and True, that have gradually been becoming explicit with the passage of the ages, and which have made men, in proportion to the degree in which

[1] John 1, v. 14.

they followed these ideals, only the more sure of Its existence.

This life then, which is also light, was in all men from the dawn of human history, in varying degree it is true, glimpsed intermittently, and partially acted upon in some cases, in many others unrecognized, undeveloped, or ignored. But it has been there all along, struggling to come to expression in the lives of men, until in the fullness of the times it came to complete manifestation and perfect expression, consciously and convincingly in One. Interpretation of the world process, of man and of Jesus Christ, along such lines, is at once for many to-day the only commendable Christian theology, and something that is necessary to round off and complete the purely scientific and even philosophical, or, as we may call it simply, evolutionary account. Or, in other words, while nothing can prevent Christianity coming under a developmental view of things, yet the world process is unintelligible in ultimate interpretation apart from the Incarnation, however conceived as to modality. To many it seems that by coherence with such a general conception must the future statement of Christian Theology be framed and judged. On such a view Nature is not merely fulfilled in grace,

but is, because of her unity, throughout, the vehicle of grace.

We have, then, to deal with a process in which there is a definite sustained movement towards higher issues through much failure, suffering, and sacrifice: and this, which is broadly true of the lower creatures, becomes focused into visibility and recognition in the case of man. His is a *résumé* of past history, and differs from what went before mainly in this, that the striving towards some higher life, if dimly appreciated, yet becomes increasingly a conscious and deliberate effort. Just because man is a moral being, he realizes that the purpose in things, which he begins to see in the degree in which his purity of life permits of such vision, can only be achieved by intelligent and willing co-operation on his part—must therefore in a peculiar way and measure be *his* achievement. 'Thy faith hath saved thee; go in peace', said Jesus, more than once,[1] to individuals who sought to attribute their recovery to His activity alone. Man thus becomes in a measure the impersonation of the purpose in the process. His vision of meaning or purpose in the process is for him his only evidence that it is a divine and spiritual process. In Jesus Christ, who was

[1] Luke 7, v. 34; 17, v. 19; Mk. 5, v. 34.

the perfect co-operator, the Logos, the purpose, became flesh.

And He is God for us,[1] because, to begin with, He is the Perfect Man, One whose experience was a conscious unity, and can only be described in any other way at the gravest peril to a true understanding of that world process in which His appearance was the most significant event. Similarly in the world process itself there is no duality of activity: the physical and the spiritual are in the closest of relationships. God is immanent in the world process; He is incarnate in Jesus Christ. His whole life, and in particular His experience, is revelation, revelation of God and revelation of Man: He is the climactic expression of the Whole. 'We can say as confidently as on any theory of the Atonement that what He did, the things which He experienced, as well as what He was, won for mankind the possibility of that conscious communion and harmony with the Divine which constitutes their well-being or 'salvation'.[2]

A discussion of this character must always

[1] Jesus never spoke or thought of Himself as God (cf. John 20, v. 17, 'my God and your God'; Mt. 27, v. 46, 'My God, my God, why hast thou forsaken me?'). Yet He was so conscious of complete union of mind and purpose with God that He could say, 'I and the Father are one' (John 10, v. 30). He showed in His life how perfect kinship is identity.

[2] J. F. Bethune-Baker, *The Way of Modernism*, p. 89.

inevitably include consideration of the question of the possibility of the ascription of Personality to that Mind-Energy that we have reason to look on as ultimate in things. Immense difficulty lies around the undertaking, and it is not to be expected that any great light will be shed upon the problem at this particular stage of thought, when so many old conceptions are passing and the new have hardly as yet taken shape. Much of the difficulty lies on the one hand in the supposition that man as we know him to-day has attained Personality, and on the other hand in the attempts to transfer to God in an enhanced degree the characteristics of the Personality that is usually ascribed to man. Both supposition and procedure are futile. Man is a very little way along the road towards complete Personality, the popular associations of which with corporeality, form, sex, age, and other terrestrial adaptations involve misconception of the essential idea in Personality, which is that of self-aware, self-determining, responsible Being. All that we can venture to affirm is that the unified, self-conscious, self-consistent, creative core of being which constitutes Personality has its analogue in some transcendent fashion in connexion with the Ground of the Universe. The ascription of other conceptions to God in any way constitutes the

most childish form of anthropomorphism. Yet anthropomorphic in some measure we cannot help being, but with increasing 'spiritual' outlook we shall be better able to estimate the nature of the problem that we have to face.

Personality is something more than individuality, something more inclusive. In getting at the heart of the conception, we are aided in thinking of the transcendence involved in self-consciousness, in the awareness of however moderate a degree as yet of self-determination, in the satisfaction of communion with like beings, in the presence of a guiding ideal that is the condition of coherence and the expression of meaning, in the deliberate pursuit of ends of realized worth. We are perfectly aware how embryonic all these characters are in the case of man even to-day, although there have been individuals who, in a greater measure than their fellows, have in one respect or another, entered at times into a liberty and expansion of mind that is not the lot of the average man. So Mozart tells how 'his symphonies came into his mind not phrase by phrase, but as a *totum simul*, accompanied by a wonderful feeling of exaltation and happiness'. In his own words: 'the whole, though it be long, stands almost complete and finished in my mind, so that I can survey it like a fine picture or a beau-

tiful statue, at a glance. Nor do I hear in my imagination the parts successively, but I hear them as it were all at once . . . the actual hearing of the whole together is after all the best. And this is perhaps the best gift I have my divine Master to thank for.'[1] In some small measure we can as it were see beyond these characters, and perceive as experimentally demonstrable fact that in the degree in which man shapes his life on the line of an individually and socially harmonious, controlled, and integrated activity, he is making it kin to the fundamental character of Ultimate Reality, as it is gradually expressing itself through men in the world process. It is just the very convincing consciousness of this in men at times that makes them sure that something corresponding to their incipient realization of Personality may be predicated of God.

To speak of God as 'a person' is not merely unorthodox, but naïve.[2] If God exists, He cannot be one of a crowd or class, however extravagant be the claims attributed to, or made for, Him as a member of that crowd. On the other hand, the world process as Becoming, is a phase of Being. It has some single ultimate Ground, for the

[1] Quoted in Dean Inge's *The Philosophy of Plotinus*, ii, 156, 157, from Holmes's *Life and Correspondence of Mozart*, p. 317.

[2] Cf. C. C. J. Webb, *God and Personality*, chap. iii.

unity of Nature is more fundamental than her uniformity. There is all the difference in the world between belief in God and belief in 'a' God. In Personality there is that that perdures. It bears a faint analogy to the Being in the Becoming. It transcends in this sense that it can think of and treat everything else—the body, the rest of the world—as in a measure other than itself. It can and does indwell that body, and make it a part of itself even more than it can indwell the piano or golf club, the artistic brush or hammer and chisel that it employs for the time being. Limitation of being may be said to be proportionate to the degree in which the self does not indwell or inform that which is other than itself, and to that extent also does it mean lack of freedom. The fullness of Personality, then, towards which man is slowly developing would seem to be this consciousness of a self able to enter into relations with others so fully and freely that there is no feeling of limitation in the experience—perfection of fellowship.[1] We can understand what this means and implies, because we can see the various stages in different forms of life. A dog may be said to have a germinal or negative sort of self-consciousness in that it

[1] Cf. Stewart A. McDowall, *Creative Personality and Evolution*, p. 59.

realizes that other dogs are *other* than it, but the degree of its fellowship with these others is obviously very limited: in the invertebrate world the conception is practically meaningless. In the case of the child we can follow all the stages in the actual evolution up to that stage of incipient Personality at which man has arrived. And by an extrapolation or intensification or magnification of what is possible even in the human relationship, we can form a faint adumbration of what Divine Personality may be and is in its absolute freedom from all other than self-imposed limitations, and its power to indwell and inform its creaturely creation. Here once again is a hint of a movement towards an end that runs through all creation; the movement towards wholeness or *in*dividuality which manifests itself as the life of organisms becomes more and more a coherent, purposive Whole. So long as man is aware of limitation in himself, it is obvious that the degree of transcendence which is his, is far short of that which is God's. And this provides a meaning in process that justifies the whole movement, and lets us see the reason for it, for otherwise it is not possible to see how such achievement of character and being could have been attained. Only by it can that 'fullness'[1] (πλήρωμα) of God be

[1] Col. 1, v. 19; Eph. 1, v. 23.

attained which St. Paul saw was the end of the outgoing and outgiving movement of God in creation. It is just the recognition of this potentiality in man that led an early writer to speak of him as being 'created in the image of God'.[1] The development towards fuller Personality is a development towards a completer transcendence, and that, in so far as it is conscious union with God, i.e. in so far as it implies an active love of God on our part, involves a sharing of His divine eternal life. Yet Love cannot *compel*: just because of this it is at once the most powerless and the most powerful force in the world. The process is a Whole; it is rational; it is patient of such an interpretation; and none other is more satisfactory to 'heart' or, we believe, mind.

God, in so far as He is creative and immanent, enters into, even as He makes, time. But in Himself, the Being in the Becoming, He is eternal and simultaneous, omnipotent and transcendent. He is the perfectly good, who is also therefore the perfectly free, with the freedom of His own self-determination. And such Being as is God's, since He is Love, implies activity, process, Becoming, for anything else is unthinkable. And it is in the Becoming that we come to know

[1] Gen. 1, v. 26.

Him. His activity as Supreme Person is both external and internal—external in creation, internal in some sense which the doctrine of the Trinity has mystically bodied forth or represented. But creation does not imply the subsequent detachment of the creature from the Creator. That was one of the errors of eighteenth-century Deism, as well as of much current theology which professes to have discarded Deism. God is not separated or distinct from His Creation at any point or at any time. Of man this is supremely true. There is a certain complementary relationship: human souls are necessary to the love of God, necessary as objects of its creative outgiving, necessary as objects of its redemptive back-leading. Without God man can never come to the full development of his being. What God creates He informs or indwells. In a measure it represents Him and is dependent on Him from an energetic point of view: the shortcoming is in proportion to the misuse of that degree of freedom which has been attained by the creature.

What exactly the relation of the Ultimate Mind-Energy to this process, of the Being to the Becoming, or in theological language (which may in time become less satisfactory than other forms for many minds) of the Father to the Son, is obviously something beyond the comprehension

of finite minds. To know that would be to be as God Himself. That very nature of the Ultimate, in virtue of which there is creation at all, which in theological language is described as Love, is necessarily outgoing, outgiving. It is the determining characteristic of the Infinite Mind-Energy or World-Ground in action. And where a man sets his life in relationship with that activity as exemplified in Jesus—for it is of a quite definite typical, and by its results verifiable, kind or 'way' of life—he himself is motived by love, and the love of God, i.e. the love exemplified or practised by God, dwells in him. Just in the measure in which God lives in us, there is an Incarnation. 'To as many as received Him'—and the process continues in operation to-day—'gave He power to become sons of God'.[1] In Jesus, as St. Paul put it, was dwelling 'all the fullness of the Godhead bodily'.[2] To Him, as the writer who best understood Him said, the spirit was given 'without measure'.[3] In the degree in which we realize that the physical and spiritual are united in every human body and that the spiritual can completely dominate, shall we begin to understand the Personality of Jesus.

[1] John 1, v. 12. [2] Col. 2, v. 9.
[3] John 3, v. 34 (A.V.).

God, in so far as He *is* Love, must eternally have some object of His solicitude, must continually be going out of Himself in creative activity. So while phases of the process may have a beginning and an end, this is unthinkable of the process in itself. Quite obviously neither Reason nor Energy nor Love can exist unrelated to some Source or Embodying Ground. The world process or the universe is a time-space epiphany or manifestation of that Ultimate and Eternal Infinite Mind-Energy which in its nature of Love exhibits itself in this form of process. Time is of the very being or stuff of process. It is succession and must enter into the very thought, structure, and experience of minds that fashion their spatial bodies in a process. It cannot be otherwise, though mind may transcend its ideas of time. But as that process is a part of the essential activity of the Infinite Mind Energy, so is time the epiphany of eternity, the only way in which the latter can be made real or intelligible to finite minds.

Once again, there is the great fact, to which reference has already been made, viz. that into the mind of man have come, or out of the mind of man have developed, ideas about Truth, Beauty, and Goodness, or as we much prefer to put it, about true, beautiful, and good living and thinking

and feeling—for discussions of abstractions seldom lead very far. Man is learning by experience that true, beautiful, and good living is the way in great part of more abundant life: it is also the outcome of service and of sacrifice. The point, however, is that with the passage of the ages the world process on the organic plane is being gradually established on these lines. The fact that men learn and by experience glimpse those ideals implies that in some sort of supreme or absolute way the latter must be characteristic of the life of the Ultimate Mind-Energy. As men understand this, they become more at one with that World-Ground: they reach out in growing appreciation and apprehension of it. In that way alone can they, so to speak, get out of themselves. It is in the recognition of this fact, regarded as an end, if not *the* end or purpose of the process, that we speak of it as ultimately a spiritual process. The experience of the World-Ground, so far as we can posit experience for it—an experience that must be very different from our limited human understanding of the term—must be complete in the sense of being perfect and all-inclusive, as also a consistent unity. So also is it with the beauty in the outworking of the process, perceptible as such by observing minds, which in its various

forms must express something in the Mind-Energy that gives expression to it or produces it in its functioning. They have value for this Ultimate Reality, and we discern that value in part. So also with goodness, the force of which men have always felt in a peculiar way just because, as the fundamental character of the functioning of the Divine Activity—'God saw that it was good'—it has therefore most naturally worked itself into the being of the supreme creative masterpiece, Man, so that he is at any rate able to appreciate—in varying degrees it is true—its urge or influence.

The method followed in these pages has been to attempt to show the essential continuity and broadly progressive character of the process, and consider the main characteristics of the highest product of that process. In man's reason and conscience we believe may be found the best evidence of the nature of Reality. It is as man exercises these faculties that he is most man, and has the feeling of at-homeness in the universe in the highest degree. God, in theological thought, is viewed as transcendent, as immanent, and as the bond of connexion that makes of all things a Whole. And there is that in the scientific understanding of the world-process which well-nigh compels some such ultimate

Ground. On the whole, with all its admitted difficulties, this acceptance seems more intellectually satisfactory than the type of admission into which some of the younger physiologists and bio-chemists are forced, as when Needham says with regard to his point of view, called by him Neo-mechanism, that 'in contradistinction to neo-vitalism and neo-finalism, it recognizes the supreme jurisdiction of the mechanistic theory of life, but admits it at the same time to be a methodological fiction'.[1] Elsewhere in the same work he maintains that 'materialism . . . is the only philosophy upon which science can get to work; methodologically it is essential'. Then he adds, 'And if I do not believe in it for a moment as a man, I recognize its fundamental importance as an experimentalist.'[2] As if the experimentalist were other than a man, other indeed in this case than the same man!

In conclusion, we may say that, while we must recognize absolute and final elements in Christianity, we can no longer consider it out of all relation to the history of religion in general, inasmuch as minds throughout the long ages of human progress have been reaching out towards God, and been found of Him. So also it is only disloyalty to God Himself for man any longer to

[1] *Man a Machine*, p. 100. [2] *Op. cit.*, p. 72.

begin with the Bible only, in his attempt to understand himself or the world in which he finds himself. It is not merely disloyal but unintelligent, for not only is the Bible a collection of writings which have had their history as individuals and as a whole, but man was on the road Godwards long before the days of the oldest contributor to its wonderful pages; and the world was in existence long before them both. We are living in a totally new world, and the knowledge of God must begin with a knowledge of the world process as it is revealed daily in the fields of observational and experimental science. Associated with knowledge of the world and of its becoming, of himself and his becoming, and the story of religion, man will appreciate the truth that is in the Bible in a new and reasonable way.[1] One of the greatest needs of this generation is the establishment in every theological seminary of a chair to be held by a layman, thoroughly equipped in some one or other of the

[1] One indication of the arrival and power of the new outlook and attitude will be seen when public opinion decides to eliminate the epithet 'Devil's' from the names of what are often beautiful, or nobly impressive, and even awesome works of Nature, as e.g. the Devil's Beef-tub or Punchbowl (of circular depressions among the hills), the Devil's Cauldron (of pot-holes in a river channel), the Devil's Elbow (of a sharp bend in a road), the Devil's Snuff-box (of the common puff-ball), the Devil's Paint-brush, and so forth.

natural sciences, who may be interested in the Philosophy of Nature and the Relations of Scientific and Religious Thought. This work, which some consider only second in importance nowadays to the study of the New Testament,[1] cannot easily be done by the ordinary theologian. And one of the great needs in an age of rapidly increasing scientific specialism is for each specialist occasionally to sit back and think out the bearings of his individual researches and of

[1] Writing on 'The Theological Education of the Clergy' in the Church of England, the Rev. Dr. F. R. Tennant said: 'Neither (i.e. the Honours or ordinary candidate in Theology) is forced to encounter difficulties inherent in the traditional theology of the Church, or difficulties otherwise presented from without—from the spheres of philosophy and science.... This is to say that, whatever else be left out—the New Testament alone excepted—room should be found in its curriculum for the essentials and fundamentals of Christian doctrine, as it stands confronted with the science and philosophy of the present day' (*The Edinburgh Quarterly Review*, April 1918).

Cf. also Dean Inge: 'It is difficult for a man to accept orthodox Christianity as the Churches present it to him without treachery to his scientific conscience' (*The Modern Churchman*, vol. xiv, p. 218).

And C. F. Russell, Head Master of King Edward VI School, Southampton, and formerly Fellow of Pembroke College, Cambridge: 'I am convinced that of all the causes which lead men at the present time to hold aloof from organized Christianity, the most potent is the unwillingness of Christian teachers to recognize frankly and fearlessly the claims of modern knowledge, and to present the truth of the Christian religion without doing violence to the equally sacred demands of truth in other fields' (*Religion and Natural Law*, Hulsean Lectures, 1922–3, p. vi).

others like it, in their relation to the larger issues of human life—to that Whole in relation to which each of us has his peculiar setting.

Science deals largely with the measurable and calculable,[1] that is to say, with the part or parts. For the Ultimate Whole she has no criterion, no measuring rod, no canons of analogy or correlation. Her powers lie in analysis rather than in synthesis. It is remarkable how at every stage she is baffled by something in relation to the Whole. Now the significance of things and organisms—their meaning—is in their Wholeness, but measurement of a Whole conveys no indication of its meaning in the same way that it does of the part. Measurement is because of relatedness to other parts, and has no significance apart from them. Measurement applied to the Whole—supposing this were possible—would not inform us about it in the same kind of a way as it does about the part.

And the challenges of the future lie just in these issues that bear on Wholeness, as e.g. how the organism is an entity whose constituent parts

[1] It is necessary, however, to state that little is gained and much is jeopardized by attempts to limit the role of science to what is quantitative, and reserve for religion the sphere of the qualitative. No such absolute distinction, as a matter of fact, exists, and neither Science nor Religion requires that it should.

normally work together for the good of the whole, how psychical activity affects or influences physical process, and vice versa in the lesser degree in which this is true. More and more it seems as if the physical and psychical were different aspects of a Whole that is however ultimately more psychical than physical, and only recently we have been warned that 'physics is no longer pledged to a scheme of deterministic law', and that if we 'reintroduce determinism at the basis of world structure, it is because our philosophy predisposes us that way, not because we know of any experimental evidence in its favour'.[1] May not the teleological be related to the mechanical as eternity is to time or mind to matter? The days in which we live are truly days of revelation: we stand on the threshold of amazing discoveries. But we shall almost completely fail and our intellectual development continually outrun our moral capacity to our undoing, if we do not regard such discovery and our related thinking as of the essence of that love and worship of the Lord our God 'with all our mind' that was placed as the culmination of true love and worship by Him of whom it was said, 'Never man spake as this man.'[2]

[1] A. S. Eddington, *The Nature of the Physical World*, pp. 294, 303.

[2] John 7, v. 46.

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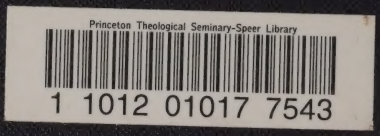
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